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AUGUST 2003
ISSN 1030-2662
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9 771030 266001 08
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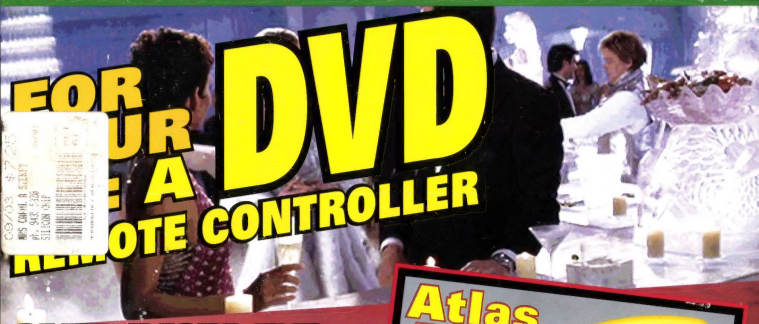

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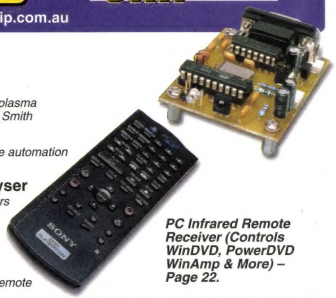

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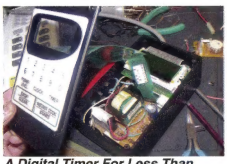

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SILICON CHIP

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Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $69.50 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

PUBLISHER'S LETTER

Should we be part of Stars Wars II?

Over the last month or so, there has been considerable news in the media about the possibility of Australia becoming involved with a deeper alliance with the USA, both in defence and in trade. As far as trade is concerned, it would probably be a good thing, especially if our farmers can get better access to the American market. However, regardless of an overall beneficial outcome, there are bound to be losers in some sectors of our economy.

A closer alliance the USA in defence is another matter entirely, and far more debatable. There are many people who would say that our existing alliance, via the ANZUS treaty, is already far too close. A majority were initially against our participation in the liberation of Iraq and we were fortunate indeed, that we did not lose any soldiers in combat (up to the time of writing this editorial, at least).

Part of the reason for the recent discussions are the worrying developments in North Korea. They reportedly already have one or two atomic bombs and they have a ballistic missile under development, to deliver nuclear weapons over long distances. Mind you, just because the North Koreans have a ballistic missile under development does not mean that they will succeed soon or at all.

Nevertheless, the Americans are working hard on producing a missile shield, based initially in Fort Greely in Alaska and on warships in the Pacific. The USA is also developing powerful laser to be carried in a Boeing 747. On detection of a missile launch in North Korea, the airborne laser would make the first attempt to knock it out. If that didn't succeed, it would then be up to a high-speed "interceptor" launched from the warships or Alaska, to kill the missile.

Inevitably, this program has been dubbed "Son of Star Wars", after Ronald Reagan's Strategic Defence Initiative which proposed having missile interceptors housed in giant "garages" orbiting the Earth. It was eventually abandoned as being infeasible and you would have to think there is a major risk that this new anti-missile venture won't succeed either. After all, there are too many ways of circumventing it. Want to protect a missile against a laser strike? Easy, just give it a highly reflective coating. Or launch a lot of decoys. Or whatever. Ways around it will be thought of, probably long before it is fully operational, if that ever happens.

The Americans are certainly spending huge amounts of money in developing this new shield and no doubt they are pushing the technology far ahead of what was possible just a few years ago. But high-tech defences are often circumvented with low-tech approaches by people who are especially determined – witness the September 11 attack in New York.

Which is why Australia should be especially wary of being involved. Sure, there might be some technology transfer to our industry but the cost of participation in this program is going to be extremely high. There are already concerns that our existing overseas defence commitments are stretching the budget too far. Arguably, we don't need to be part of any "missile umbrella".

That is not to say we should not continue to work with the USA under the existing ANZUS treaty. But let us hope that heavy diplomatic pressure brought to bear by the United Nations and particularly China can relieve the precarious situation in North Korea. That is how Australia should be working, not in an extremely expensive high-tech approach which has no guarantee that it will work.

Leo Simpson

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Cat 1008057-7 RFID Proximity Reader 200mm **$269**
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MAILBAG

Camera flash capacitors pack a punch

In the "Mailbag" section of the May 2003 issue, a comment was made questioning the claims made by Adrian Righetti concerning the power of the main capacitor in a camera with a built-in flash.

I am a camera technician and I can ensure you that the flash capacitor can pack quite a punch. It needs to so it can supply enough current for the flash. My fellow technicians and I always take extreme care when working inside "live" cameras because misplaced tools, or worse still, fingers touching the capacitor terminals can cause unpleasant results as experienced by Adrian.

When working on cameras, we discharge the capacitor using a standard domestic 60W light bulb fitted with two wire leads and probes. The bulb glows briefly as it safely discharges the capacitor.

Michael J. Murphy,
Camera Clinic,
Collingwood, Vic.

Copy protection a nuisance

I'd like to comment on K. Poulter's letter in the May, 2003 issue of SILICON CHIP.

I do agree that copy protection is not a good thing for the general public. I purchased a number of CDs from EMI that use a technology called "Copy Control". I am not sure how this works but the CDs will not play in the CD player I have in one computer and only sometimes play in my car. Yet I have still succeeded in making perfect copies of these CDs and also ripping them into high quality MP3s (all for personal use). The technology only makes the product inferior for the average user; it will not stop a savvy user from copying the music at all.

Macrovision copy protection is also a problem. I have a relatively new flat screen television. I notice that the copy protection causes the picture to flicker in brightness horribly when darker scenes are playing. I have disabled all of the picture enhancement functions in my TV and DVD player but the problem still exists. If I disable Macrovision in the output of the player, the problem disappears.

I am a very experienced computer user. I have at my disposal the experience and the technology to pirate almost anything. It doesn't mean that I do. I pay for what I really like and if I wouldn't pay for it, then it's really not worth me having anyway. I believe that most people are the same. It's only a small minority that want to get everything for free.

Adam Hawes,
via email.

Making cutouts in plastic boxes

I noted the letter in Mailbag (July 2003) concerning the reader having difficulty cutting rectangular holes in plastic boxes.

As an electronics enthusiast I had the same problem and like Keith Anderson from Tasmania, I could do something about it. I personally redesigned our range of popular Jiffy ABS boxes so that there is now a pre-scored grid inside the lids. This gives the option of a large variety of rectangular hole cutouts.

You can simply use a sharp hobby knife to cut all the way through the lid. The result is an accurate hole perfectly aligned to the edges of the box.

Gary Johnston,
Jaycar Electronics.

Electrician's licence does not guarantee safe work

I have been following the debate on the need to have an electrician's license to do electronics work. Recently, I purchased a split system air conditioner from a large local electronics retailer. They arranged for the installation by a licensed electrician. I was unhappy with the installation and am still annoyed. Some of the problems were:

(1) Damaged brickwork on the wall where a new earth stake was installed. This presumably happened when the stake was being hammered in. Seven bricks were damaged. This damage would have been easy to avoid by placing a piece of timber or cardboard against the wall.

(2) The new switch for the air conditioner was loose when installed in the power box. It appeared that the self-tappers used to attach the switch had stripped their threads after being over-tightened.

(3) The power cable in the ceiling was not installed according to the official wiring rules, (AS/NZS 3000: 2000), as I understand it. The wire ran unprotected across the ceiling, where it could be walked on. The electrician blamed the apprentice, a statement which opens a whole can of worms.

To correct the matter, after I complained, the electrician cut the existing cable in the middle and added an extra length of cable using two junction boxes. This allowed the wire to be rerouted. This is contrary to the book "Electrical Wiring Practice" by K. Pethebridge and I. Neeson, 3rd Edition, Volume 1, page 86, McGraw-Hill, 2002, which states "Arguably, the most vulnerable components of an electrical installation are the electrical connections. For this reason, it is good wiring practice to arrange an installation with as few connections/joints in the cable as possible".

I conclude that this licensed electrician does not follow the rules and in any case, when challenged, does not adopt good wiring practice, even when relatively large currents are involved.

(4) Apparently, while the air conditioning manufacturer has no policy

regarding the attachment of air conditioning units to Gyprock wallboard, the current unit was attached to the wall using hollow wall bolts (similar to toggle bolts), where the wallboard bears the weight of the air conditioner. The Gyprock company informed me that they definitely discourage this type of installation. It would have been very easy at the time of installation to attach the unit to the wall studs, which would have provided much better support. The electrician informed me that the use of hollow wall bolts is common practice.

I have further problems with the installation but enough has been said. Having a licensed electrician do the installation has not in any way assured me of good or safe workmanship. Quite apart from having requisite knowledge, so much depends on the individual doing the work.

Where has pride in workmanship gone?

Name and address withheld at writer's request.

Quartz halogen lamps and UV light

Your editorial about the inefficiencies of low voltage halogen lamps (June 2003) happily coincided with my reading a book entitled "Why the Watermelons Won't Ripen in Your Armpit" by one Ben Selinger, noted on the cover as being a leading chemist and science populariser. In a section about UV lighting in discos, he makes the following observation.

"The quartz halogen lamp operates at a higher temperature than conventional globes and produces ultraviolet radiation which its quartz envelope lets out. In the midday summer sun, the recommended daily exposure for UV is reached in about 15 minutes. At 25 centimetres' distance (one foot), a 50-watt quartz halogen globe without filter can deliver the same amount of UV in about 15 minutes. This increases to 40 minutes at 50 centimetres, two hours 40 minutes at 100 centimetres, and a full working day at 175 centimetres (inverse square law)."

Also coincidentally, my daughter mentioned that she and her husband were contemplating fitting a quartz lamp over the top level of a bunk bed, to do duty as a reading lamp. I need hardly spell out what I thought of that idea!

I find it very frustrating that remarks such as yours and of Mr Selinger are only read by a very small section of the community. They are, in my opinion, matters that should be given much wider publicity, along with a lot of other information that should be of concern to all of us.

I. R. Anderson,
Albany, WA.

50 years of electronics magazines

Can I say how important SILICON CHIP is to me. I purchased my first "Radio and Hobbies" copy over 50 years ago, in May 1953. It was the very first book I ever purchased and was the only technical thing I had ever seen.

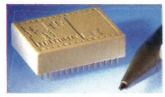
Nobody I knew understood anything about such things and it was without doubt the beginning of my technical life. I went on to study engineering and read for a PhD at Cambridge on a scholarship. I became a civil engineer but I have never lost my interest in things electrical.

I still have almost ever copy of R&H and the rest of that series and of SILICON CHIP. Forgive me if I think of the two publications as one Australian popular electronics magazine. I read recently a high-level US technical national planning group noted with concern the demise of the electronic hobbyist. They went on to say they believed such activities were very important initiators of vocational paths that were themselves vital for the technical soul of a nation.

I think R&H started me along such a path and I am sure many other readers will relate to what I am saying. In that context, SILICON CHIP is in elite company as I don't think there are many publications like yours anywhere in the world still running and with such a long history.

For almost the full 50 years mentioned above, you have always had a story about servicing. I would purchase SILICON CHIP for this article alone. You seem to find folk who can tell these wonderful stories. My experience is that these two things rarely go together so what comes out each month is even cleverer.

The Tiger comes to Australia

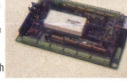


The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multitasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

TIG505 Single Board Computer



The TIG505 is an Australian SBC using the TCN1/4 or TCN4/4 Tiger processor with 512K FLASH and 128/512K RAM. It has 50 I/O lines, 2 RS232/485 ports, SPI, RTC, LCD, 4 ADC, 4 (opt.) DAC, and DataFLASH memory expansion. Various Xilinx FPGAs can add 3x 32bit quad shaft encoder, X10 or counter/timer functions. See www site for data.

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It was rather sad to read the critical remarks in "Mailbag" in the June 2003 issue, about the work habits of your current writer and I was delighted to read the rebuttal and justifications offered; how logical, reasonable and measured.

Can I also comment on the honesty of your current writer? I think everyone who fixes things does things which they later realise were not so smart; like discharging a capacitor by making a transistor conduct with your multimeter and taking out half the board. I can relate to that so very well. Yet I wonder how often I have admitted such follies to myself let alone writing about it in a national publication.

Your current "Serviceman" writer is so refreshing! All of the writers and especially your current writer have provided me and I imagine countless others with endless enjoyment and a great deal of fault-finding wisdom. There are so many lessons to be learnt from fixing things that go far beyond what has actually been gained by whatever it was that was fixed. I have much admiration for people who make a living out of it.

Kenneth E. Moxham,
Urrbrae, SA.

Digital TV is impractical

As a collector and restorer of vintage B&W TV sets, I've been following the "analog TV switch off" question with interest and I am in total agreement with your July editorial concerning the failure of terrestrial digital TV.

There are two points which seem to be conveniently ignored by those trying to force it upon us. The proponents of Digital TV seem to think that we will view it via a large screen TV in the living room (hence the additional push for high definition).

Coming back to reality, a typical Australian house has more than one TV. If the analog signal is switched off, each of those sets will require a digital decoder. For a house with four TV sets, the cost to equip them all with decoders is already around the $2000 mark. The proponents may say to feed all the sets from one box. That's fine if everyone wants to watch the same channel but that's usually not the case. And if someone wants to record a different channel, that means yet another set top box for the VCR.

The second issue of concern is with portable TV sets. How am I meant to use my miniature battery (rechargeable, of course) operated TVs? Am I meant to wear a backpack containing a 12V battery, inverter and digital decoder just to watch my pocket LCD TV set when I travel?

The fact is there is no valid reason to switch off our analog TV service. We are fortunate in having the 625-line PAL system in Australia. It is tried, proven and inexpensive technology. With a decent aerial and a properly adjusted set, it is very hard to fault it.

The sensible option would be to keep digital for pay services where interactivity and multiple channels may justify it but leave the FTAs as they are.

On the subject of domestic halogen lighting, apart from the gross inefficiency, the thought of a hot transformer hidden away in the ceiling catching fire is enough to put me off. That's not to mention the UV radiation.

Finally, has anyone noticed that, sadly, 240V incandescent light bulbs are no longer made in Australia?

John Hunter,
via email.

Blue glow in valve not a death sentence

I would respectfully take issue with you regarding the answer you gave in the July 2002 issue (page 91) to R. R. of Ocean Reef, WA, about discharges in valves.

In a rectifier such as an 80, a mauve to pink glow between the filaments and the plates definitely indicates a gassy tube and it is indeed kaput.

On the other hand, a blue fluorescent glow on the mica supports or the inside of the glass envelope indicates a very high vacuum and a good tube. This phenomenon was also apparent in output tubes when it could be seen fluctuating with the signal. It made a very striking display with the nice contrast between the (electric?) blue of the discharge and the red glow of the heaters or filaments. This pretty display was probably the only advantage that valves ever had over transistors!

Alan March,
via email.

Blue glow in valves OK in some cases

In your reply to R. R., Ocean Reef, WA, in the June 2003 issue, you state that "Any valve with a blue discharge is gassy – it's kaput".

This situation is generally the case where the blue discharge is between the elements of the valve. However, a blue fluorescence on the glass which pulses with the output and often seen on the larger output valves such as 6L6-Gs, 807s and the like, is indicative of a good valve with high vacuum. Less common would be gas-filled rectifiers such as the type 83 in which the gas ionises during normal use.

John H. Wark,
via email.

Visions of the future

Since buying a USB flash memory card recently, I have been having visions of the future while playing with my new toy. The cost at present is about $500 per Gigabyte. Soon it will be $100/Gb. At first I imagined booting up any computer with my own data. But why not the operating system as well?

All those bulky drives, CD, HD, etc, are for the chop. Why not a 10cm cube black box with power and the CPU, to which peripherals can connect? These could be spread all over the world. Why not have all this in a flat-screen monitor in homes, cafes, libraries, offices, schools, telephone boxes, transport, etc? Plug in your USB card and you're away! Costs would be small and go automatically onto your credit card. Sufficient security would be provided by built-in voice operation.

Jim Jacobs,
Engadine, NSW. SC

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05-03

OLED DISPLAYS – Better than Plasma or LCD!

By PETER SMITH

Flat panel displays come in two types: LCD and Plasma. Right? No, there's a third type just being introduced – the Organic LED, or OLED display. It is brighter, has much better contrast, wider viewing angle, uses less power and has faster response time. It looks set to take over as the flat panel display of choice, for small appliances, computer monitors and large TV sets.

In 2002, OLED displays began to appear in small consumer appliances like cameras and mobile phones. The superiority of this new technology will ensure that it replaces LCDs in many more applications within the next few years. And that might just be the beginning!

What is an OLED?

Scientists have long known about the electroluminescence of organic crystals. Early attempts at generating light with organic electroluminescent (EL) devices were not developed past the experimental stage, as they required high excitation voltages (upwards of 100V) and were very power inefficient.

An important step in the evolutionary process began with the use of thin-film organic layers. The first EL thin-film device used a single organic layer sandwiched between two injecting electrodes (Fig.1).

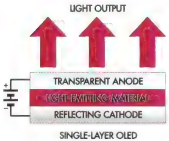
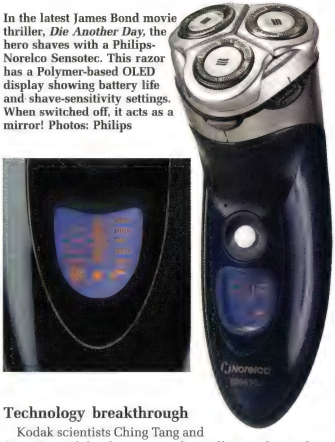


Fig.1: the first EL thin-film device used a single organic layer sandwiched between two injecting electrodes.

Operation of these single-layer devices is relatively straightforward. When a voltage is applied across the electrodes, holes are injected from the anode and electrons from the cathode. These carriers migrate through the organic layer until they meet and recombine to form an exciton. Relaxation from the excited to ground states then occurs, causing emission of light.

Single-layer EL devices are impractical because of the extremely accurate matching required between the electrodes and the organic material. Essentially, mismatching results in carriers crossing the structure without combining with an opposite sign, thus wasting energy.



In the latest James Bond movie thriller, *Die Another Day*, the hero shaves with a Philips-Norelco Sensotec. This razor has a Polymer-based OLED display showing battery life and shave-sensitivity settings. When switched off, it acts as a mirror! Photos: Philips

Technology breakthrough

Kodak scientists Ching Tang and Steve Van Slyke demonstrated an efficient, low-voltage OLED for the first time in 1987. Their device used two layers of organic thin-film material.

In the two-layer EL device, one layer is optimised for hole injection and transport while the other is optimised for electron injection & transport. In this way, each sign of charge is blocked at the interface between layers, in effect "waiting" until a partner is found.

Tang and Van Slyke also improved on the composition

Kodak's EasyShare LS633 zoom digital camera, available in Australia this year, sports an AM550L 2.2" active-matrix display. Kodak boasts that the display is so good that you don't need a PC to own one! Photo: Kodak

OK, so Kodak like the model! LCD versus OLED: the advantages of having a wide viewing angle are clearly demonstrated in this shot. Photo: Kodak

and construction of the EL cell, resulting in a bright, efficient device that operates on less than 10V.

Due to the monopolar nature of the organic layers, EL devices conduct current in one direction only; in other words, they behave like diodes, hence the common name "OLEDs".

In one and two-layer devices, the organic compounds must perform two major functions. They must be luminescent as well as hole/electron transporters. By incorporating a third organic layer chosen specifically for its luminescent qualities, researchers have been able to further improve efficiencies by optimising each layer for a specific function.

OLED structure

Fig.2 shows the physical structure of an RGB OLED cell. A conductive, transparent anode material such at indium-tin-oxide (ITO) is first deposited on a transparent substrate. Next, the organic layers are added. Lastly, a reflective metal cathode of magnesium-silver alloy or lithium-aluminium completes the structure. Incredibly, the thickness of the structure, minus the substrate, is only about 300nm. This means that most of the total weight and thickness is due to the substrate itself.

OLED types

To date, OLEDs can be divided into two groups, depending on the processes used to apply the thin-film organic layers during manufacture. Small Molecular OLEDs (SMOLEDs) use organic material with very small molecular structures. This allows the layers to be built using sophisticated vacuum vapour deposition.

On the other hand, Polymer OLEDs (Poly-OLEDs) utilise organic polymers, which consist of much larger molecular structures. These are commonly applied with simpler solution processing (spin coating) methods.

Recent advances in chemical-resistant polymers have also enabled traditional photolithography technichques to be brought to bear. Inkjet printing methods have also proved popular due to their high resolution and "on-the-fly" design versatility.

OLEDs in colour

Using fluorescent dopants in the luminescent layers, manufacturers have been able to produce OLEDs in many colours, including the three primaries (red, green & blue).

White OLEDs are realised with the use of dual emitting layers of complementary colours. By individual control of the drive level to each layer, hue can be adjusted from pale yellow to light blue.

OLED displays versus LCDs

Because of their small size and relatively high efficiency, OLEDs are ideally suited for use in flat-panel

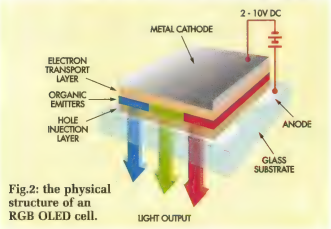


Fig.2: the physical structure of an RGB OLED cell.

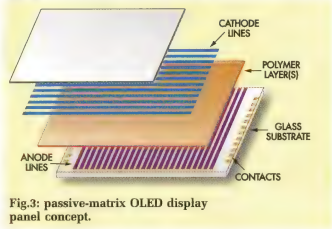


Fig.3: passive-matrix OLED display panel concept.

displays. Liquid crystal display (LCD) technology is the current leader in this area. So how do OLEDs stack up?

As you've probably guessed, OLED displays offer significant advantages over LCDs. Being self-luminous, they require no backlighting. By contrast, LCDs require either an external light source (reflective type) or a fluorescent or LED backlight (transflective type). No backlighting means OLED displays are smaller in size, use less power, weigh less and cost less.

Their self-luminous nature is also responsible for two other important advantages. First, they have a virtually unlimited viewing angle (165°). LCDs, on the other hand, are limited by the "aperture" effect. In addition, they have very high brightness and contrast (>100:1). This is something that LCDs can't hope to match. A backlit LCD typically looks "washed out" under bright light.

Equally importantly, OLED displays have almost instantaneous update speed. The response time of LCDs has always been a problem, particularly when displaying real-time video. The microsecond switching speeds of the OLED has entirely eliminated this issue!

In summary, OLED displays have:

* High brightness and contrast
* Ultra-wide viewing angle
* No backlight required
* Thin, compact form factor
* Fast response time
* Low power consumption

Display types

In common with their LCD counterparts, OLED displays are currently being manufactured in both active and passive types.

Passive-matrix display panels are typically created by depositing the electrode material in a matrix of rows and columns (Fig.3). An OLED is formed at the intersection of each row and column line. Display electronics can illuminate any OLED (pixel) in the array by driving the appropriate row line and column line. A video image is created by sequentially scanning through all rows and columns, briefly switching on the pixels needed to display a particular image. An entire display screen is scanned ("refreshed") in about 1/60 second.

Active-matrix displays use TFT (thin-film transistor) technology. Every OLED cell is controlled by at least two transistors. All transistors in the array are individually addressable in a row/column format. However, unlike the passive-matrix display, the transistor circuits retain the state (on/off) and level (intensity) information programmed by the display electronics. Therefore, the light output of every pixel is controlled continuously, rather than being "pulsed" with high currents just once per refresh cycle.

Active-matrix displays are considerably more expensive than passive displays, but they boast brighter, sharper images and use less power.

Monochrome (single colour) displays are generally of the passive type. Full-colour displays may be either active or passive. Similarly to other display technologies, the full colour spectrum is generated by modulating individual red, blue and green OLED cells positioned side-by-side in a "triad" arrangement.

Universal Display Corp. has recently announced a different architecture for full-colour display. In their Stacked OLED (SOLED), they stack red, green and blue sub-pixels on top of one another instead of next to one another. This provides a three-fold increase in display resolution and enhances picture quality.

Prototype of a high-resolution, full-colour passive-matrix PolyLED display, fabricated with inkjet printing techniques. Photo: Philips Research.

Availability

Researchers still have a lot of work to do before OLED displays are ready for the majority of mainstream applications. Of particular concern is the longevity and intensity of the light-emitting layers. In addition, manufacturing methods need to be improved in order to produce high yields at low costs.

Small passive-matrix OLED displays can already be found in many consumer items, such as mobile phones, hand-held games, music systems and in-car instrumentation.

Kodak and Sanyo Electric Co., Ltd., produced the first full-colour 2.4" active-matrix OLED display in 1999. Less than a year later, they produced a larger, 5.5" model, and in 2002 demonstrated a 15" display. Since then, at least one manufacturer has demonstrated a 19" full-colour display.

The first commercially available active-matrix display is to be found in Kodak's new EasyShare LS633 zoom digital camera, available in Australia this year (see photos).

Where to next?

According to some sources, more than 80 companies and universities around the world are involved in OLED research. Clearly, there is a great deal of interest and much potential in this new technology.

For example, several companies have recently demonstrated highly flexible display panels fabricated on plastic substrates. Apart from making panels much more robust, this breakthrough could also allow very cheap mass production, where displays are produced in a roll-to-roll, printed medium style.

Yet another discovery involves the use of non-metallic transparent anodes. Manufacturers will soon be able to make OLED panels that are over 85% transparent (when not active). The applications are mind-boggling!

More reading

This web page has a list of useful links to OLED researchers and manufacturers: www.chipcenter.com/eexpert/dbraun/main.html SC

Home Automation and Experiment 10

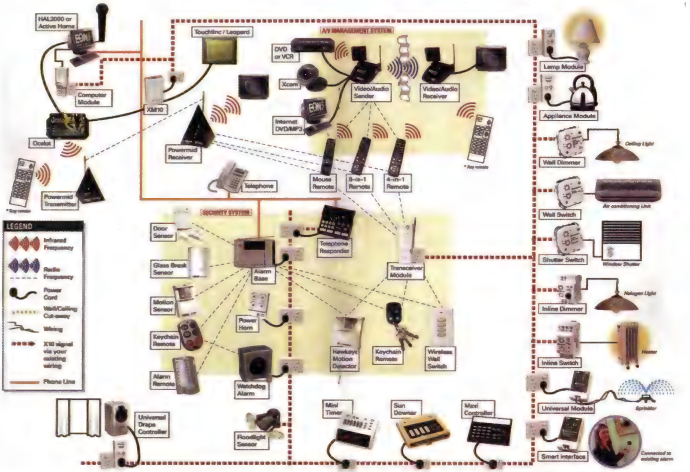
Even though it has been around for twenty years or more, X10 and Home Automation are terms you may not have come across yet – but ones you'll be hearing a lot more about in the (near) future. And what is X10, anyway?

Just the other day, I was reading a newspaper article which said that home automation would never catch on in Australia because no-one could agree on a standard – sort of the old VHS vs Beta or Windows Vs Mac thing again.

I reckon the writer was half right – but for totally the wrong reason. Home Automation equipment has been around for a while but by and large, it has certainly been the light hidden under the bushel. And it's all been too mysterious, too hard.

Perhaps the writer had also never heard of X10 – the technology which has arguably already become the de-facto standard, with a whole lot of equipment available right

By ROSS TESTER



This diagram gives some idea of the applications you can put home automation to. The rest, as they say in the classics, are limited only by your imagination. (Courtesy of EON3).

now to automate your home as much (or as little) as you want.

Sure, there are plenty of other "standards" being espoused by their various manufacturers. Some use variations of X10, others are orphans of their manufacturer's making.

But worldwide, the one that seems to have caught on is X10.

X10 is actually a technical standard which specifies how digital control signals are superimposed onto your existing house (mains) wiring. Manufacturers and suppliers marketing equipment which operate to this standard simply call them X10 devices.

Whatever operates from power (even via a plugpack) can be automated. This can be total automation, where your personal computer is programmed to feed those control signals you're wanting into your power wiring, or it can be totally manual, using infrared or RF control units to link you, the user, to the X10 control system. Or it can be anything in between.

And with 256 "addresses" available, you're gonna run out of things to control long before the X10 system uses up its capabilities! For more information on X10, see the separate panel "So what is X10 all about anyway?".

X10 is not particularly new – it's been around for more than twenty years and many manufacturers around the world have picked up on it. By and large, though, home automation products have been aimed at installers – sparkies, in particular – so that they can on-sell the systems AND install them, especially during new home construction or renovation.

Perhaps that has been another reason why home automation hasn't really caught on yet: there hasn't been an extensive D-I-Y range available or mass-marketed (and before someone jumps down our throats for that remark, think about how many adverts you have seen for home automation products that you can install yourself).

That is all about to change. We are specifically looking at the EON3 system, a true "end user" application that simply plugs in to existing wall outlets, so anyone can buy and install it. True, that makes it only applicable to plug-in appliances and devices – if you want to fit it to your permanent room lighting you'll still need add-on devices intended for the purpose and an electrician. That aside, there are many, many devices in the home which are "plug in" and are ideal candidates for home automation.

Such as? Heaters, lamps, many air cons, security systems, kitchen appliances (eg, the kettle for the morning cuppa), entertainment systems . . . the list really does go on and on.

Incidentally, the EON3 system is available through Dick Smith Electronics, who kindly arranged the bits and pieces for us to have a play (we understand that the system is set up in the DSE PowerHouse stores so you can have your own play!).

Home automation?

First, we perhaps should look at that term "home automation" and what it means – and more importantly, what it can do for you.

And before I get accused of plagiarism, I'm unashamedly quoting almost verbatim from an EON3 brochure here – because they have obviously put a lot of thought, time and effort into the whole subject. (We'll look at EON3 itself much more closely in a moment).

> *Imagine... a remote control that operates your lights, the temperature inside your home, your front door lock, in fact all of your electrical appliances.*
>
> *Imagine... living in a fully automated home where the electrical devices respond to your voice.*
>
> *Imagine... being able to turn on your air conditioner while driving home from work, unlocking the security system as you round the corner, and having your favourite track of music playing as you step through the front door.*
>
> *Imagine no longer... Eon3 is here . It's highly affordable, it's simple to use and it's fun... you can control your lights, security system and other appliances from a single remote control, through your home or office computer, even by voice.*
>
> *Lights and sound can be timed to operate as if someone is home, even while you're on holiday. A video link to your work computer enables you to keep an eye on your home and children, when you're miles away.*
>
> *The elderly and disabled will feel safer and more secure. A simple press on a pendant can turn on all the lights in the house and call a family member or neighbour.*
>
> *Eon3 will change the way you live, leaving you time and energy to enjoy all the good things of life. That's if you can stop playing with the Eon3 system.*

I like that last comment, because it *is* true. We've had various Eon3 system components here for a couple of weeks now and I for one can't stop playing with them!

In a nutshell, the computer tells the appropriate appliances when to turn on or off, via code sent via the very power wiring to which that appliance is connected. The computer knows because YOU have told it when YOU want it to issue those commands.

A selection of X10 Home Automation gear from EON3 (available at Dick Smith Electronics). At left is the Computer Kit (including CD-ROM) which allows your computer to control any X10 gear. Centre is the Lighting Kit, along with a go-anywhere (no wiring) switch panel and a PIR module. At right is the Home Theatre automation kit with the lighting kit X10 lamp adaptor.

And that comment about voice control is right – just say "dim living room lights to thirty percent" and the living room lights will dim to (surprise!!!) 30%. Hey, this is pretty nifty stuff!

So home automation can be whatever you want it to be. It can be as large a system as you require (or your budget will allow) or it can be a single unit operating just one device.

Incidentally, you've probably seen adverts for all sorts of home automation devices already available (and have been for some time): air conditioners that you can set by phoning them up, remotely controlled security systems, webcams that react to intruders and alert you at work – there are many examples.

Not all operate on the X10 standard, though many do. Many still require separate (Cat 5?) data cabling to get the commands from point to point. Perhaps that's what the newspaper article was alluding to about incompatibilities.

Control anything

The main feature of X10 is that it allows virtually anything to be controlled – and controlled in the way you want it to be. We're not just talking on/off here: as the example above showed, we can be talking lights dimming to whatever levels you want. Heating/cooling systems setting the comfort levels you want. Music playing at whatever level you want. Blinds or shutters opening and closing to whatever position you want. Your home theatre or AV system running the program you want, at the volume level you want, at the time you want – even automatically muting if the phone rings. Want to switch TV channels? No problem.

We could go on and on here: suffice to say that anything capable of being switched on/off or set to a specific level, is a candidate for home automation. I don't think there is much that *doesn't* fall into those categories!

In the ultimate system, *everything* in your home could be automated. And indeed, one day (probably sooner rather than later) could well be.

We've looked at a number of websites while preparing this feature. Already they are saying that homes without built-in automation are passe; that they'll be harder to sell in the future. Over-enthusiastic copywriters? Perhaps. But they were saying the same things about ensuites twenty years ago!

What if you don't want something automated? What if you prefer to have it (whatever "it" is) operate totally under your control?

Again, no problem: even if automated, you still retain total control. You can override what the computer is telling the device to do. (Of course, it's only telling it to do it because you told the computer that's what you wanted it to do in the first place . . .)

Just how easy is it?

For a start, you don't need a computer (no, we are not contradicting what we just said. All will be revealed). All you need is an X10 device which is capable of sending the appropriate signals and a receiver which picks up those codes from the power line and activates . . . whatever.

A good example is the EON3 Home Automation Lighting Kit. This is very much a "startup" kit, an easy and low cost

way to get into home automation if you like, which can be installed in – literally – a couple of seconds. It contains a 10-button credit-card sized RF remote control, a transceiver module (which translates the RF signals into powerline signals) and a socket module which plugs into any standard (bayonet cap) incandescent light socket with the bulb itself plugging back into the module.

You simply plug the transceiver module into any wall socket; plug the socket module into the lamp socket, reinsert the bulb and turn power on to both. Pressing the appropriate on and off buttons on the remote control will now turn the lamp on and off. (This assumes they are on the same phase; in the vast majority of home installations they will be. If they are not, there are ways around the problem).

As a bonus the transceiver module itself contains a 3-pin mains outlet and doubles as an appliance module, so you can control, say, a kettle, coffee maker, electric blanket, other (plug-in) lamps, TV set . . . whatever you want!

It really is that simple. But it can be so much more. This kit can be the start of a complete home automation system, simply by adding the bits you need.

For instance, there is a "Stick-A-Switch" remote wall switch which, as its name suggests, simply sticks to any wall surface using (supplied) self-adhesive pads. It is about the same size as a conventional wall plate switch but has three on/off switches and one bright/dim switch. It can switch the same light as fitted to the socket module or can switch other lights fitted with appropriate receivers.

Just think of the wiring hassles that would solve!

Another EON3 kit is the Home Automation Theatre Kit. Instead of the little remote, this one has an 8-in-1 universal remote control which can be used to control all of your audio/video equipment as well as lighting and other mains controlled appliances throughout your home. It contains a transceiver module (like the lighting kit) but instead of the socket module it has a lamp module which can be individually programmed and addressed.

Again, though, installation should take no more than a few seconds – and this kit too can be added to just as much as you wish.

Computer Control

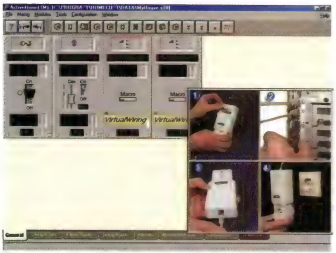
Now we're talking (or controlling!)

The Home Automation Computer Kit contains not just a lamp module and appliance module as detailed above but a computer module which is the interface between your computer and the power line (it can also work as an independent programmable controller).

Most importantly, though, this kit contains (on CD-ROM) a program called "Activehome" which allows you to set up your own command schedules to do, well, whatever you want it to do.

Once again, anything that can be switched on or off or have its level changed can be controlled. We've shown a couple of screen grabs of this Windows software which we found delightfully simple to use.

One point to watch, though: the Computer Module links via an RS232 port. These days, that shouldn't be a problem because most modern computers have spare RS232 ports (inbuilt modems and PS2 meeces have seen to that). Unfortunately, not the computer I first tried: it had an external modem and serial mouse so I had no ports available (yeah, I know, the computer is an old clunker which should have been pensioned off years ago!).



Screen grabs from the ActiveHome Home Automation software. They even give you step-by-step fitting instructions!

Swapping over to a new PC cured that problem very easily – but it is something to keep in mind if you want to put an old PC into service.

HAL

We noticed in the EON3 brochure that the voice controlled software for the system is called HAL2000. The delicious symbolism of this name won't be lost, I'm sure, on anyone who has seen Kubrick's classic, "2001: A Space Odyssey"!

Remember the astronauts talking to HAL, in plain English? Well, that's exactly what you do here: "HAL, change the bedroom TV set to Channel Seven . . ." and HAL does it. We just hope that HAL doesn't lock the front and back doors on you when you go to put out the rubbish bin . . .

Add-ons

Of course, HAL is but one of a myriad of add-ons available for the EON3 system. There are all sorts of modules designed to do all sorts of things: interfaces to the real world, telepone line interfaces, timers, security controllers, video cameras, video senders, remote control extenders . . . et cetera, et cetera.

Many of these devices, however, are designed to operate fixed wiring devices in and outside the home (eg, room lighting, built-in air conditioners, ovens, pool/spa heaters and pumps, etc).

That means, of course, that an electrician **will** be needed to wire these devices in, because it is illegal to do your own wiring in Australia. Having said that, we return to the statement we made at the opening: EON3 has more than enough plug-in bits and pieces to keep you amused for days – and you CAN install these yourself.

Conclusion

Home Automation has arrived in a big way. As we said before, EON3 isn't the only system around. But it is here, it is now, and it is for the do-it-yourselfer.

And it's fun!

Thanks to Dick Smith Electronics for the chance to play with the EON3 Home Automation gear!

So what is X10 all about, anyway?

Believe it or not, X10 really does stand for "Experiment 10". Back in the 1970s, a Scottish company, Pico Electronics Ltd, was developing ICs for the growing calculator market. Each time they launched a new project, they gave it a number, which they called "experiement". Their shorthand was to call their experiments X-1, X-2, and so on, up to X-8.

Then, around 1978, British Sound Reproduction (BSR) asked Pico to develop an IC to operate their programmable record changer (X-9). Then BSR wanted a wireless method of remote control – which Pico labelled X-10.

This evolved, around the middle of 1979, into a system which sent control pulses through the mains wiring. X-10 was born – even though for some time it was known as BSR System X-10 and X-10 Powerhouse. Somewhere along the line the dash was dropped and it became X10.

Zero-Crossing Sync

X10 relies on a fairly simple data frame with a predetermined start code followed by two sets of data bits. That part, certainly, is not rocket science.

What makes X10 work is the way it is synchronised with the zero-crossing point of the 50Hz mains AC waveform (in both positive and negative directions). As there is no "data" wiring between devices, each device has a zero-crossing detector so that it knows exactly when the waveform is at zero volts.

Almost immediately after this moment, it examines the waveform to see if there is a high-frequency pulse, usually 120kHz, also present. As you know, one cycle of the 50Hz mains voltage is 20ms long. But the X10 device looks for just 0.6ms of this period. (The actual transmitted pulse should be 1ms long, allowing a margin for error).

If a pulse is detected, it then looks at the next zero-crossing point for another pulse. A pulse followed by no pulse is taken to be a binary "1", while no pulse followed by a pulse is taken to be binary level "0"

The code

But wait a minute: doesn't that mean that a binary 1 could be confused with a binary 0?

No, because X10 also looks for two other things: at least 6 zero-crossings without pulses (or 000000), followed by a start code sequence of pulse, pulse, pulse, no pulse (or 1110).

Immediately after the start code, a letter code data is sent – 4 bits of either 1's or 0's which correspond to the letters A-P. Immediately following this, a number or function code is sent – 5 more bits which correspond to the numbers 1-16.

Now if you multiply 16 by 16, you should come up with 256 – which (not) coincidentally is the number of addresses possible under the X10 system.

This whole code sequence (start code, letter code, number code) is (or should be) sent twice for reliability. So the complete X10 data transmission will occupy 47 cycles, or the best part of one second. It is quite possible, even probable, that the X10 receiver will correctly receive the first half of the code and react in well under a second. But there is always some lag between the action of sending a code sequence and the receiver's reaction.

Before any new data is sent (eg, a different command), there must be at least six "empty" zero-crossings (three cycles).

50Hz vs 60Hz and 310MHz vs 433MHz

In Australia and much of Europe, we use a mains frequency of 50Hz. North America, which has been (by far) the largest market and had the largest development of X10 devices, uses 60Hz. It also (generally) uses a mains of 110V compared to our 240V.

So will US X10 devices work in Australia and vice versa? Umm – maybe. First of all, the X10 specification doesn't care too much about supply voltages – so that shouldn't be a drama. But the 50Hz vs 60Hz may be a problem. The reason is that mains is generated in three phases and X10 is theoretically supposed to work across phases. (Note that – theoretically!).

Therefore, it is not just looking for a signal at the zero crossing point of an AC waveform – if it was, that would be fine. But it is also looking for a signals at specific points in the AC waveform which would correspond to the zero crossing points of the other two phases. And they are obviously different for 50Hz and 60Hz.

What does all this mean?

While US prices of X10 equipment are often significantly lower than Australian (it's mostly to do with volumes and size of market), you would be better off buying X10 equipment designed for our 50Hz system. Yes, you can buy controllers which automatically detect frequency – but they cost more and are probably not worth the hassle.

One final point: a lot of the wireless data equipment in the US operates on 310MHz (or thereabouts) whereas the Australian LIPD approved band is around 433MHz. Most 433MHz X10 equipment from various suppliers should be compatible; mixing 310MHz and 433MHz certainly will NOT be.

Want more reading? Google X10 and you'll be swamped (mainly by manufacturers or suppliers).

You could try **http://www.geocities.com/ido_bartana/toc.htm** – it's a great place to start. **SC**

X10 Alphabet Codes

A	0110	E	0001	I	0111	M	0000
B	1110	F	1001	J	1111	N	1000
C	0010	G	0101	K	0011	O	0100
D	1010	H	1101	L	1011	P	1100

X10 Numeric (Function) Codes

1	01100	5	00010	9	01110	13	00000
2	11100	6	10010	10	11110	14	10000
3	00100	7	01010	11	00110	15	01000
4	10100	8	11010	12	10110	16	11000

Atlas LCR Passive Component Analyser

Do you need a quick and easy way to measure resistors, capacitors and inductors? Well, this little gem from Peak might be just what you've been looking for!

Compound instruments that can measure inductance, capacitance and resistance find many uses in a typical electronics workshop. They can help you to decipher an unreadable code on a component, or select a specific value component from within a tolerance band.

They're also very useful when you want to fine-tune your carefully crafted inductor, current shunt or the like. And of course, they can quickly tell you if the value of a component is what it's supposed to be.

Traditionally, instruments with sufficient accuracy and range to perform all of these functions well have been expensive and difficult to use. Peak Electronic Design appear to have satisfied all of these requirements with their Atlas LCR Passive Component Analyser.

Metrics

Unlike bench-top LCR bridge meters, this little beauty is battery-powered and fits in the palm of your hand. It is supplied with a short, wired-in test cable terminated with two small hook clips. These are suitable for measuring most leaded components.

The clips are attached to the wire ends via a simple pin & socket arrangement, allowing replacement with longer reach clips or tweezers for surface-mount device measurement (optional extras).

Ranges:

1µH to 10H inductance (±1% ±0.8µH accuracy)
0.4pF to 10µF capacitance at ±1% ±0.3pF accuracy)
1Ω to 2MΩ resistance at (±1% ±0.6Ω accuracy)

The front panel consist only of two pushbuttons and a 16-character, two-line liquid crystal display.

Making measurements

Measuring a component is as simple as hooking up the clips and pressing the "on-test" button. The instrument switches on, and after a short delay (which can be avoided by pressing the button again), the component is automatically identified, measured and the value displayed.

For inductance measurements, a test frequency of 1kHz, 15kHz or 200kHz is selected automatically according to size. The test frequency used, as well as the inductor's DC resistance can be displayed by scrolling down with the "scroll-off" button.

For capacitor measurements, the instrument uses AC impedance analysis for values less than 1uF and DC transient analysis for larger values. Again, the test frequency is determined automatically and can be displayed by hitting "scroll–off".

As the test voltage used is only about 1V, is it usually unnecessary to worry about the polarity of tantalum and electrolytic capacitors when hooking up the test leads. In addition, a low test current of 3mA means that you can safely measure (most) components in-circuit.

Of course, in-circuit measurement is not always possible or practical and in fact, the manufacturers do not recommend in-circuit testing, because the readings may be misleading.

Note that capacitors must be fully discharged before connection to the test leads. The instrument will refuse to perform a measurement if it detects voltage and displays an error message instead. We've no doubt that a capacitor charged to a high voltage level would destroy the instrument (and void the warranty!).

Calibration

Probe compensation (nulling) can be performed at any time by holding down the "on–test" button and shorting the clips together. This is generally only necessary before measuring low inductances (<10µH) and resistances (<10Ω) or after swapping probes.

Impressions

This is definitely a "user-friendly" instrument. With its two-button operation, 1% basic accuracy and relatively low price, Peak has devised a highly practical piece of test gear that would be welcome in any workshop.

Where to get one

The Atlas LCR Passive Component Analyser can be purchased directly from the manufacturers in the UK: **www.peakelec.co.uk**

Price, including shipping (airmail) & 12 months warranty is £77.23. At the exchange rate current at the time of writing this review, that is equivalent to about $AU193. **SC**

BENCHMARK AUG 2003
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A highly accurate air speed and temperature meter producing an easy-to-read digital temperature display in Celsius and Fahrenheit, air speed in metres per second, kilometres per hour, knots, feet per minute and miles per hour. Also measures the average air velocity from multiple locations (up to 8) and single point average airflow, which is ideal for servicing air conditioning systems.

Q 1302

$299 NEW

DUAL TRACE 20MHz BASIC CRO

This affordable CRO suits a wide range of applications. Features dual trace, dual trigger CRO with fully adjustable sweep time (20 steps) and sensitivity, selectable trigger modes, AC, TV-H and TV-V trigger coupling, plus more!. Complete with two CRO probes.

Q 1802

$498 LOW PRICE!

Lux and Fc Light Meter

An easy to use pocket sized meter that accurately displays light level in terms of foot-candles (fc) or lux over a wide range. Features a 3.5 digit LCD, low battery indicator, max and hold functions.

Q 1367

$68.94 NEW

SonicTape with Laser Pointer

Measures distance using a laser pointer for an accurate direction of measurement from 0.6m to 15m and features computation of area and volume. Requires one 9V battery.

Q 1507

$99.94 NEW

BRYMEN Deluxe Multimeter

Features a fast 4,000 count digital display, an analogue bargraph on the LCD and is capable of a dual display mode. Ranges include AC/DC volts, AC/DC amps, resistance, conductance, frequency and capacitance.

Q 1565

BRYMEN

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An easy-to-use cable tester that can verify cable continuity, short circuits and incorrect wiring of Cat.5 RJ45, RJ11 and coaxial LAN cables. Comes complete with three connector leads in a protective carry case.

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Tired of people not switching off your lights after switching them on? With an ENSA (ENergy SAving) WIRELESS light switch you never have to worry about switching another light on or off again! It's the simple solution that AUTOMATICALLY switches lights on when you enter a room and switches them back off after a set time! For added convenience, ENSA wireless light switches can be controlled by your Watchguard home alarm system allowing you to switch your lighting on and off via your alarm's remote control, PIR detector, reed switch etc.

The ENSA wireless light switch can be installed in minutes by a licensed electrician without any extra messy electrical cabling!

Wireless Alarm System

- ENSA compatible
- 2 high security remotes to arm/disarm the system
- Capable of split arming sensors
- Includes 2 wireless passive infrared sensors, a mains control unit, internal and external siren, strobe light, backup battery, mains power adaptor and 10m of cable *L 8319*

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X-10 Home Automation Home Control Kit

Control your lights and appliances from anywhere in your home with this simple screw-in installation kit including a key-chain remote control, socket rocket and a transceiver module.

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X-10 Automation Home Theatre Kit

Controls appliances, lighting and other infrared devices. Includes an 8-in-1 learning remote control, a lamp module and an appliance module.

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L 8048

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Compact and lightweight, the NightEagle provides excellent night vision by amplifying any available source of light. Features 2.4x magnification and is powered by a single 9 volt battery. Includes carry case.

L 8191

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NEW

STL Marine Night Vision

A high quality and lightweight night vision unit that is compact and waterproof down to one metre. Features 2.5x magnification, a viewing range of 200m, a built-in IR illuminator range of 90m and a rubber armoured construction for enhanced durability. Powered by two AA batteries and includes a carry case.

L 8192

$499

NEW

STL Night Vision with Sound Amplification

Cutting edge military technology allowing night vision and sound amplification. Features a water resistant casing, 2.5x magnification, a viewing range of 200m, a built-in IR illuminator range of 90m, rubber armouring and a sound recording jack. Powered by two AA batteries and includes a carry case and headphones.

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A complete DIY colour camera kit that features simple plug and play connectivity into a TV, VCR or video monitor. Includes a camera with an advanced high quality colour lens, cable and power adaptor.

L 5910

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P 8920

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digitor AT104 Submersible Water Pump

Features a 1900 litre per hour flow rate and a 2m lead. Operates on a 24V AC 1.5A power supply (M 9635 – not included). Rated: 24V AC 1500mA.

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Play DVDs and MP3s on your PC via infrared remote control!

PC Infrared Remote Receiver

Dedicated DVD players come with full remote control. Now you can have remote control for the DVD player in your PC with this easy-to-build unit.

SINCE THE PUBLICATION of our MP3 Jukebox back in October 2001, we've had many requests for a similar remote control system for DVD players. This time around though, we've dispensed with the liquid crystal display in favour of on-screen display (OSD) and designed a simpler, lower-cost infrared receiver.

Like the previous design, this unit hooks up to a free serial port and can be installed inside your PC or mounted externally. It even includes the ability to power up your PC remotely!

In conjunction with free Windows remote control software, it can be used to drive a popular DVD player (WinDVD 4 or 5) and MP3 player (Winamp 3). In fact, if you're a keen programmer, you can set it up to control just about any Windows application you desire.

Project overview

The hardware part of the project consists of a single, small PC board that receives and decodes infrared transmissions from a remote control handpiece.

Most off-the-shelf universal remotes can be set up to work with the receiver. In addition, we've included specific support for Sony Playstation remotes, as they include all the function keys necessary to simplify DVD player control.

After processing by an on-board microcontroller, received key presses are transmitted to your PC via a simple serial port connection.

If installed inside a PC, the receiver can be powered from the motherboard's Wake-on-LAN (WOL) connector, enabling it to "wake up" the PC from sleep mode on reception of a pre-programmed infrared command.

It can also be mounted in a small project case and powered from a plugpack if so desired. This may be more practical in cases where the PC system unit is on the floor or hidden behind a desk.

Key codes received on the serial port connection are interpreted and acted on by a program called "Girder". This unusually named software package is probably one of the most versatile remote control packages of its kind. It can be programmed to perform just about any action within the Windows environment based on events from a variety of sources.

Playing DVDs

With DVD players now available at rock-bottom prices, why would you want one on your PC? Well, PC-based players allow you to do all sorts of things that you can't do on stand-alone units, like capturing frames and creating playlists.

On the other hand, perhaps you eat

By PETER SMITH

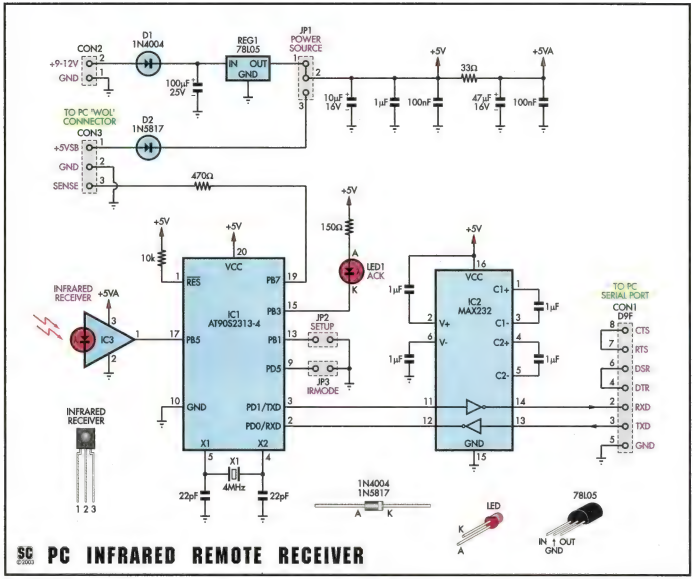


Fig.1: the design is based around an Atmel AT90S2313 microcontroller (IC1) supported by an infrared receiver & demodulator (IC3) and an RS232 receiver/ driver (IC2).

and sleep next to your PC and it's the convenience factor that you find attractive! Whatever the reason, it's a fact that most new PCs are shipped with CD-ROM drives that can read DVD discs. All that's required (in most cases) to play a DVD is the addition of a software player package.

For use with the infrared receiver, we've selected WinDVD, reputedly the most popular software DVD player around. If comes pre-installed on many name-brand PCs, or can be purchased in retail shops or on the Internet at **www.intervideo.com**. Note that only versions 4 & 5 are guaranteed to work with our remote control software.

If you're thinking of purchasing online, then it's a good idea to "try before you buy". A fully functional evaluation version is available that will work for 14 days from date of installation. Minimum hardware and software requirements are all listed on InterVideo's web site.

Playing MP3s

The best (we think) and cheapest (it's free) MP3 player in the universe is Winamp 3, so it was an obvious choice for this project. You can download it from Nullsoft's web site at **www.winamp.com.**

Note: we recommend that you install your player software and check that it is working properly before attempting any other part of this project. Be sure to load the software into the default directories suggested during the installation processes.

Remote-controlling Windows

Conventional Windows applica-

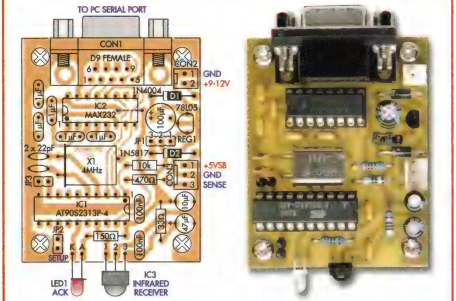


Fig.2: follow this diagram to build the receiver module. Take care with the orientation of the two ICs , diodes D1 & D2 & the electrolytic capacitors.

tions expect to receive their instructions from the mouse and keyboard. For example, to start Winamp playing, a mouse click on the "play" button is required. The trick is to augment this behaviour so that a press on a remote control's "play" button does the same thing.

This is where Girder comes in. Girder can translate events from any number of sources, including commands from an infrared remote, into actions that any application can understand.

Girder is designed to be all-purpose, so it's not supplied pre-programmed for any particular application. Our job was to program Girder to work with WinDVD and Winamp in conjunction with a number of popular remote control handpieces.

Once Girder is programmed with the necessary instructions, the results can be saved to disk in a file (called a "group" file, with an extension of ".GML") for easy recall later. The group files we've created for WinDVD and Winamp can be downloaded from the SILICON CHIP website but more on that later.

Infrared remotes

The infrared receiver module is designed to work with any "universal" type remote control – see panel entitled "About Infrared Remotes" in this article for all the details.

It's important to note that because the function keys vary widely between remotes, we can not guarantee that all models will work well with the key assignments that we've programmed (see Tables 1 & 2).

For best results, use one of the specified remote controls. Doing so means that you won't have to poke around inside Girder to reassign keys codes – something that we'd probably only recommend to those with a good understanding of Windows programming!

OK, by now you should have some idea of how everything hangs together.

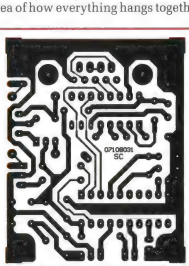


Fig.3: this is the full-size etching pattern for the PC board. Check your board carefully before installing the parts.

Before assembling the hardware, let's have a closer look at what makes it tick.

How it works

The circuit diagram in Fig.1 reveals a simple but effective design. It is based around an Atmel microcontroller (IC1) supported by an infrared receiver & demodulator (IC3), an RS232 receiver/driver (IC2) and a power supply (D1, D2 & REG1). Power can be provided from either a 9-12V DC source or a 5V DC source.

The 9-12V input (CON2) should be used in all cases except when the module is mounted inside your PC and you want to use the remote power-up function (see below). This input can be powered either by an unregulated 9V DC plugpack (freestanding unit) or a spare disk drive connector from the PC power supply (internally mounted).

Reverse-polarity protection is provided by diode D1. Following this, a 100µF capacitor provides some filtering upstream of a 78L05 3-terminal regulator (REG1). The regulator output provides the +5V supply rail for the circuit.

Remote power-up

Alternatively, to make use of the remote power-up function, +5V standby power must be applied to the CON3 input. This is sourced from the motherboard's Wake-on-LAN (WOL) connector and is present whenever AC power is present.

All ATX (ACPI 2.1 compliant) motherboards we've seen have a 3-pin, single-row header for the WOL function. Two pins provide the standby power output (+5VSB and GND), while a third (SENSE) is a digital input. This pin can be driven high to bring the PC out of power-down or sleep modes.

Although originally designed for use with PCI networking cards, the WOL function is rarely used on home/small office machines.

Back on the receiver board, the +5V standby power input is reverse-polarity protected by D2. We've used a Schottky diode for this circuit rather than a rectifier diode to minimise forward voltage losses.

Additional filtering of the +5V rail is required for the sensitive analog circuitry inside IC3. This is provided by a 33Ω resistor and 47µF capacitor,

which together form a simple low-pass filter.

Infrared reception

IC3 contains all of the circuitry necessary to receive and demodulate the remote's 38kHz (±2kHz) infrared transmission. The recovered digital signal appears on pin 1 and is piped directly into the microcontroller (IC1) on pin 17.

The microcontroller decodes the serial stream in accordance with either the Philips RC5 or Sony SIRCS protocol definitions. Switching between the two protocols is performed "on the fly", based on information in the first part of the received data.

Each "chunk" of data from the infrared remote contains both a code for the key pressed and an equipment address (VCR, TV, CD, etc). This is packaged with a synchronisation (start) byte and a checksum byte and then transmitted out the micro's TXD line (pin 3).

IC2 converts the transmitted data from TTL signal levels to ±10V (nominal) RS232 levels, after which it appears on the D-9 connector (CON1) at pin 2.

Each time the micro receives a key press from the remote, it flashes the "Ack" LED by driving pin 15 low for about 100ms.

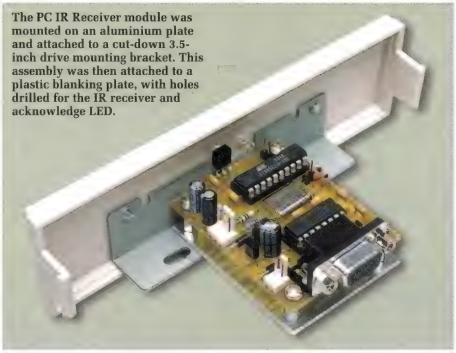
Assembling the IR receiver

All parts mount on a small PC board, coded 07108031. Using the overlay diagram in Fig.2 as a guide, begin by installing the single wire link using tinned copper wire. Follow up with the four resistors and two diodes (D1 & D2).

Next, install the two sockets for IC1 and IC2. These go in opposite ways around, so be sure that you have the pin 1 (notched) ends oriented as shown. Don't plug in the ICs just yet, though. Leave them out until you're ready to test the completed unit.

The crystal (X1) can go in next. It mounts horizontally, so bend the leads at 90° (about 2mm from the body) before soldering it into position. To hold it firmly in place, solder a short length of tinned copper wire to the top edge of the can and the pad directly below.

Install all of the capacitors next, aligning the positive leads of the three electrolytics as indicated by the "+" marking on the overlay.



The PC IR Receiver module was mounted on an aluminium plate and attached to a cut-down 3.5-inch drive mounting bracket. This assembly was then attached to a plastic blanking plate, with holes drilled for the IR receiver and acknowledge LED.

The completed unit slots into a spare drive bay on your PC or can be used as a freestanding module.

All remaining parts except for the LED and infrared receiver (IC3) can be installed next. LED1 and IC3 should be set aside until you've devised a mounting method for the module. You'll then be able to gauge the required lead length and bend needed to position both devices so that they protrude through any panelwork.

Note: the microcontroller (IC1) must be programmed before it can be used in this project. If you've purchased a kit, then this will already have been done. However, if you're sourcing all the parts yourself, then you'll need to either buy a pre-programmed microcontroller or program a "blank" device yourself. The microcontroller program file (IRR.HEX) can be downloaded from the SILICON CHIP web site. Pre-programmed microcontrollers (and PC boards) are available from RCS Radio, phone (02) 9738 0330.

Installing the module

The small size of the receiver board will allow it to fit comfortably behind a 3.5-inch or 5.25-inch drive-bay blanking plate. A right angle bracket attached to the 3mm holes on the PC board is one possible mounting method (see photos).

It could also be fitted to a 3.5-inch to 5.25-inch drive adapter (eg, Jaycar Cat. XC-4630) if your PC has a spare 5.25-inch drive bay.

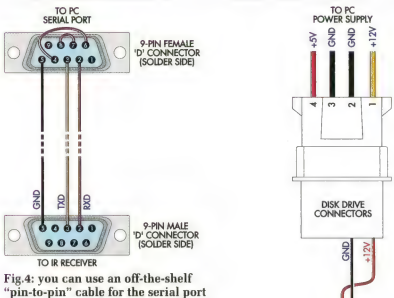


Fig.4: you can use an off-the-shelf "pin-to-pin" cable for the serial port connection or make your own using the connections shown here.

Fig.5: if you're mounting the module inside your PC but don't need the power-up function, then make up this cable for connection to a spare disk drive power socket.

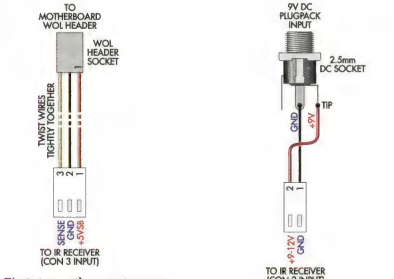


Fig.6: to use the remote power-up function, you must power the module from the motherboard's WOL header. Here's how to wire up the necessary cable. Keep the length as short as possible and twist the three wires tightly together.

Fig.7: if you're building a freestanding unit, then power the unit from a 9V DC plugpack. You'll need a panel-mount DC socket for the plugpack connection, wired up as shown here.

Another option might be to attach it to a convenient spot on the metalwork behind the case cover. It all depends on the design of your case as well as how much time you're willing to spend to make the result look "original equipment"!

Note: all tracks (including ground) on the rear of the PC board must be isolated from the PCs metal casing. Use non-metallic brackets, nylon/plastic stand-offs or some other method to ensure isolation.

Don't want to fiddle around inside your PC? Well, you can also install the module in a small instrument case and power it from a 9V DC plugpack. This method offers the advantage of being able to position the unit anywhere in your room!

Whatever mounting method you choose, the hole for the infrared receiver (IC3) must be drilled a little larger than the bump on the package so that the lens is not obscured. The receiver lens should then be positioned inside the hole, with the body of the package flush with the rear of the panelwork.

In addition, light from the LED must not illuminate the infrared receiver, as this will interfere with its operation in low-light situations.

Serial cabling

For connection between the module and your PC's serial port, you'll need a D-9 male to D-9 female "pin-to-pin" cable. If you're making the cable yourself refer to Fig.4 for the wiring details.

For internally mounted modules, the cable must be routed out through the rear of the case in order to connect to one of the external 9-pin serial port connectors. The quickest way to achieve this is to remove one of the brackets adjacent to the PCI expansion bus and feed the serial cable out through the exposed slot.

Note that ready-made serial cables with large moulded backshells may not fit through the slot. In this case, you can cut the (male connector) end off and replace it with your own D-9 solder type connector, without a backshell.

Alternatively, make up a cable using IDC-style connectors & IDC cable. This method works well, because you can route the cable neatly inside the case and only make it as long as it needs to be.

Power cabling

As mentioned previously, internally mounted modules can be powered from either a spare disk drive power connector (Fig.5) or the motherboard's Wake-on-LAN (WOL) connector (Fig.6). The latter connection is re-

quired in order to use the remote power-up function.

The motherboard WOL header is generally of the 2mm-pitch variety. Unfortunately, sockets to mate with these high-density headers are not currently available from the usual kit suppliers.

We made ours up from a WOL cable that was supplied with a PCI network card. You may be able to score one of these from your local PC equipment installer. Alternatively, a 2mm-pitch socket for unshrouded type headers is available from Farnell Electronic Components, Cat. 672-300.

Note: the WOL header (and some parts of the motherboard circuitry) are live whenever AC power is applied. Disconnect AC power from you PC before connecting/disconnecting cables or inserting/removing PCI cards. Refer to your motherboard manual for the location of the header and the position of pin 1.

Setting up and testing

Check that jumper JP1 is set according to the power source that you've chosen and remove jumpers JP2 & JP3 if you fitted them earlier. Now apply power and reach for your trusty multimeter.

The following measurements are all made with the negative probe connected to any convenient ground point (the negative side of the 10µF or 47µF capacitors, for example). If the module is powered from the WOL header, then the voltage drop across D2 will reduce all of the readings by at least 0.4V.

With your meter set to read volts, measure at pin 20 of IC1 and pin 16 of IC2. Both readings should be about +5V. That done, measure pins 2 and 6 of IC2. These readings should be about +9.5V and -9.4V, respectively.

OK, let's check out the infrared receiver section. First, set up your infrared remote as per the instructions in the "About Infrared Remotes" panel. Now point your remote at the infrared receiver and press any key. The "Ack" LED should flash each time a key is pressed.

Programming the power-up function

Disconnect power from the receiver module and install a jumper shunt on JP2. Power up again and point your remote at the receiver. Press the key that you wish to use as the power-up key (usually the "Power" key!). The "Ack" LED should flash five times to indicate that the new key has been accepted. Now power off and remove the jumper.

The microcontroller stores the key code in on-chip EEPROM, so it is not lost when power is disconnected. However, the code can be reprogrammed at any time by repeating the above steps.

Before the power-up function will work it must be enabled in your PC's BIOS setup. Generally, you can access the BIOS setup by hitting the <Esc> key during power up.

Once in the BIOS setup, look for the "Power Management Setup" menu (or similar). There you'll need to enable both the "ACPI" and "Resume on LAN" options. The menu probably also displays a long list of APM (power management) options. You should not need to alter any of these for the WOL function to operate.

Note: power management setup menus vary considerably between motherboards. Refer to your motherboard manual for details on how to enable the Wake-on-LAN function.

Well, that completes the hardware part of the project. The next task is to download and install the Windows remote control software.

Downloading Girder

Point your browser to **www.girder.nl** and go to the main download page. Click on the "Girder Installer" link at the top of page to download the latest version. At time of writing, Girder was at release 3.2.9b but this will obviously change over time.

Parts List

1 PC board coded 07108031, 100.5mm x 117mm
1 3-way 2.54mm SIL header (JP1)
2 2-way 2.54mm SIL headers (JP2, JP3)
3 jumper shunts
1 20-pin IC socket
1 16-pin IC socket
1 9-way 90° PC-mount female 'D' connector (CON1)
1 3-way 2.54mm SIL connector & socket (CON3)
1 2-way 2.54mm SIL connector & socket (CON2)
9-way RS232 cable (D9M to D9F) for serial connection (see text)
Red, black & yellow light-duty hook-up wire
Small cable ties

Semiconductors
1 AT90S2313P-4 (or –10) microcontroller (IC1), programmed with IIR.HEX
1 MAX232 RS232 receiver/driver IC (IC2)
1 38kHz infrared receiver module (IC3) (Jaycar ZD-1952, Altronics Z-1611)
1 78L05 +5V regulator (REG1)
1 1N4004 diode (D1)
1 1N5817 or 1N5819 Schottky diode (D2)
1 3mm red LED (LED1)
1 4MHz crystal, HC49 package (X1)

Capacitors
1 100µF 25V PC electrolytic
1 47µF 16V PC electrolytic
1 10µF 16V PC electrolytic
5 1µF 50V monolithic ceramic
2 100nF (0.1µF) 50V monolithic ceramic
2 22pF ceramic disc

Resistors (0.25W, 1%)
1 10kΩ 1 470Ω
1 150Ω 1 33Ω

Additional parts for internally mounted module:
1 4-way cable mount PC disk drive plug (Jaycar PP-0743) OR-
1 3-way 2mm-pitch SIL header socket for WOL (see text)
Mounting hardware to suit

Additional parts for freestanding unit:
1 plastic instrument case, "UB1" size or similar
4 10mm tapped spacers
4 6mm pan head screws
4 6mm countersunk head screws
1 2.5mm panel-mount DC socket
1 9V DC 150mA (min.) plugpack

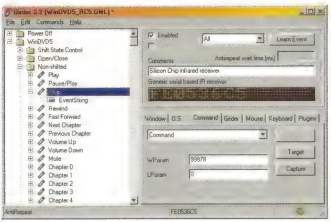


Fig.8: Girder looks after all the remote control stuff in Windows. Here it's shown ready to direct all the action in WinDVD 5.

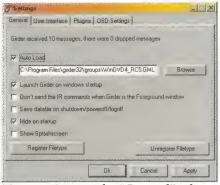


Fig.9: settings on the "General" tab control Girder's startup and shutdown options.

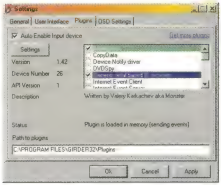


Fig.10: our system requires the use of several extensions, or "plugins", to do everything we've asked of it. This is where we tell Girder which plugins to load. Some plugins have their own settings dialog, accessed by highlighting the plugin name and clicking on the "Settings" button.

In addition to the Girder Installer, three "plugins" are also required for this project. Plugins are used to extend the functionality of Girder, as we'll see shortly. Click on the "Plugins" link at the top of the main download page to go to the plugins download page.

Download the following three plugins by clicking on their respective links: "Generic Serial IR", "Popup OSD" and "Winamp 3".

Installing Girder

Navigate to wherever you saved the Girder Installer file and double-click on it to launch the installation. Follow the prompts to complete the installation, using the default options as presented.

OK, let's install the three plugins. Begin by unzipping the "Generic Serial IR" file, named "uir_m_1.5.zip" (or similar), into a temporary directory. This archive contains just one file, named "uir_m.dll". Move this file into the Girder plugins folder located at "C:\Program Files\girder32\plugins".

Next, unzip the "Popup OSD" file, named "PopUp.3.0.6.zip" (or similar) into the temporary directory. This time you'll see two files, "PopUp.dll" and "ReadMe.txt". As described above, move the "PopUp.dll" file into the Girder plugins folder.

Finally, unzip the "Winamp 3" file, named "Winamp-1.6.zip" (or similar) into the temporary directory. You'll notice that a folder named "plugins" has been created in the temporary directory. Under the "plugins" folder is another folder named "Winamp3" and a file named "Winamp3.dll". Again, move the "Winamp3.dll" file to the Girder plugins folder.

Go back to the temporary directory and open the "Winamp3" folder. You'll now see another folder named "wac". Open this folder, and inside you'll find a file named "girder.wac" and a folder named "xml".

Move both the file and folder to the Winamp plugins folder at "C:\Program Files\Winamp3\Wacs".

If all that sounds a little confusing, have a look at the "readme.htm" file included in the ZIP archive. It explains in detail where each file should reside.

To check that they're in the right places and operating correctly, launch Winamp and press <Ctrl><P> to open the "Preferences" window. Scroll down to the bottom of the list and you should see an entry named "Girder" (see Fig.14).

Note: future plugin releases may use different filenames to those described above. If in doubt, refer to the documentation included with the download or check out the on-line help at ***www.girder.nl***

Download & installing the "group" files

Your Girder installation is now almost ready to go. All that remains is to program it for the task at hand, which in this case is to control either Winamp or WinDVD in conjunction with the infrared hardware.

We've already done the programming job for you and the fruits of our labour are available for download from the SILICON CHIP web site. Point your browser to **www.siliconchip.com.au** and then click on the "Software Downloads" link on the left side of the main page. Download the "GirderGroups.zip" file listed for this month and unzip it into a temporary directory.

Navigate to "C:\Program Files\girder32" and create a new folder named "groups" to hold the new files. Now move the files unzipped above into the new folder at "C:\Program Files\girder32\groups". You'll note that there are six files in all:

(1) Winamp3_RC5.GML,
(2) Winamp3_SONY.GML,
(3) WinDVD4_RC5.GML,
(4) WinDVD4_SONY,
(5) WinDVD5_RC5.GML; and
(6) WinDVD5_SONY.GML.

As you can see from the names, we've provided group files for Winamp 3, WinDVD 4 and WinDVD 5. There are two sets of files for each application, one for use with universal remotes (RC5) and one for Playstation remotes (Sony).

Setting up Girder

Launch Girder from the Windows Start menu. From the main menu bar at the top of the Girder window, click

on *File* and choose *Settings*. The "Settings" dialog box appears with the "General" tab visible (Fig.9). Click on the "Browse" button and navigate to the group files that you saved earlier in "C:\Program File\girder32\ groups". Double-click on the file appropriate for your setup.

For example, if you want to control Winamp with a universal remote, choose "Winamp3_RC5.GML".

Next, click on the "Auto Load", "Load Girder on Windows startup" and "Hide on startup" check boxes to enable them. These options ensure that everything happens automatically at Windows startup.

Still on the "General" tab, click on the "Register Filetype" button. This creates an association between the Girder application and it's group (.GML) files.

Skip over the "User Interface" tab, as the default settings are generally OK. Instead, click on the "Plugins" tab (Fig.10). Enable the following plugins by clicking in the boxes next to their names: "AlarmTimer", "Generic serial based IR receiver", "OSD PopUp" and "Winamp3".

If any of the last three plugins aren't listed, then you may not have installed them correctly. Go back and double-check that you've copied all the relevant files into the Girder plugins folder as described under "Installing Girder".

Now click on the "Auto Enable input device", followed by the "Apply" button. That done, we can now set up Girder to receive data from the infrared receiver hardware.

Serial port & infrared receiver configuration

Highlight "Generic serial based IR receiver" in the plugins list and click the "Settings" button. The "Device configuration" dialog should now appear (see Fig.11).

Change the settings as necessary to match those shown in Fig.11. Make sure that all of the options listed under "Device Settings", "Timings" and "Filtering" are disabled (not ticked)!

In addition, two settings need to be altered to suit your system. Under "Port settings", select the COM port that you've using with the infrared receiver, and set the "Code length" to match your infrared remote. For a universal remote, choose "4" bytes. For a Playstation remote, choose "5".

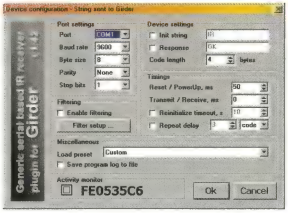


Fig.11: key codes from the infrared receiver are picked up by this plugin, which then passes them on to Girder. Your settings should look like this, although you may need to change the "Port" and "Code length" entries (see text).

That done, click on the "OK" button to close the configuration window.

Note: if you've highlighted the "Generic serial based IR receiver" and clicked on the "Settings" button but nothing happened, then chances are that the "Device configuration" window has appeared behind the main Girder window. Look down on the Windows task bar. If you see a "Device configuration" button, click on it to make the window visible.

On-screen display settings

Finally, click on the *OSD Settings* tab (Fig.12). Information here determines the basic format of the on-screen displays and can be changed to suit your taste. The default character size is much too small, so click on the "Select Font" tab and change the font to "Arial" and the size to "20" as a reasonable starting point.

Click on the "Apply" and then the "OK" buttons at the bottom of the "Settings" window to complete your Girder setup.

If you're still with us, you should now have a fully functional system.

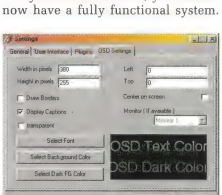


Fig.12: system-wide OSD (On Screen Display) settings can be customised here.

From the main Girder menu, select *File -> Exit Girder*, then restart your computer.

System checkout

When Windows starts, Girder should start up automatically. An icon in the System Tray will be the only indication that it is running. Point your remote at the receiver and press the "Open/Close" button to launch your chosen application.

You should now be able to control the most commonly used Winamp/ WinDVD functions via remote control!

Controlling both Winamp & WinDVD

So far, our instructions have assumed that you only want to be able to control either Winamp or WinDVD. To control both applications on the same system, you need to switch between the two Girder group files.

Let's say that you've set up Girder to automatically control Winamp at startup, but now you want to switch to WinDVD. To do this, double-click on the Girder icon in the System Tray to open it. Next, from the main menu bar, select *File -> Open* and load the group file for WinDVD control.

You can then send Girder back to the System Tray by selecting *File -> Close Window* or by clicking on the "X" in the top right corner of window. That's it!

Help, it doesn't work!

OK, so you've pressed a key, the "Ack" LED on the receiver board flashed, but nothing happened in Windows.

First up, try launching Winamp/ WinDVD manually and see if they respond to key presses. If remote con-

Fig.13: shed your basic Winamp skin and slip into something sexy! This is just one of many available for download from www.winamp.com

trol is now working, this suggests that the key we've assigned for the Open/Close function is not compatible with your remote. In this case, you can either start the application manually or reassign the key code for the Open/Close function (see Tables 1 & 2 and "Reassigning remote keys" below).

Still not working? OK, let's make sure that Girder has loaded the group (.GML) file and that it's receiving the key presses.

Double-click on the Girder icon in the System Tray to open it. Along the top of the Girder window, you should see the name of the currently loaded group file. The contents of the file are displayed on the left side of the Girder window. This is the programming information that instructs Girder on what action to take when it receives a remote key press.

If there's no indication that the group file was loaded, then go back over the steps under "Setting up Girder" to correct the problem.

Assuming it was loaded successfully, point your remote at the receiver and press any key. The 4-byte code for the key should appear on the status (bottom) bar of the Girder window.

If it does, have a close look at the number displayed (it's in hexadecimal notation). The first byte is always FE (the sync byte), the next is the equipment address, the third is the key code and the last byte is the checksum.

It is vital that the second byte of the string is 05, as this is the equipment address for VCRs. If it's some other value, then you've chosen an incompatible device code for your remote. Refer to the information in the "About Infrared Remotes" panel for details.

Note: the above information applies only to universal remotes set up for Philips (or compatible) appliances. For Playstation remotes, the code will be five bytes long and cannot be incorrect.

If you're still with us, we assume this means that nothing is displayed on the status bar when you press a key on your remote. The most likely problem at this point is either incorrect setup of the "Generic serial based IR receiver" plugin or a problem with serial communications from the receiver module.

Start by double-checking the settings for the plugin, as described under "Serial port & infrared receiver configuration" above. Note that the last received key code should be displayed under "Activity monitor" on the bottom line of the configuration window.

No go? Then you can determine if the serial connection is working by monitoring the COM port input with any serial terminal application. HyperTerminal (included with Windows) will do the job, although all you'll see when you press a key is a bunch of strange ASCII characters.

To see the actual key code values, you'll need a terminal application that can display in hexadecimal. Check out RealTerm, available free from **realterm.sourceforge.net**. Set it up to match the chosen COM port, with a baud rate of 9600bps, 8 data bits, 1 stop bit and no parity.

Note: Girder must be closed before attempting to access the serial port from any other application. To do this, select File -> Exit Girder from the main menu.

These are the four remotes recommended for use with this project (left to right): Sony Playstation remote, Jaycar BC-3000, and Altronics AIFA RA7 & AIFA Y2E.

Reassigning remote keys

If you're using a different universal remote to the ones in our list and the function keys don't do what you want,

About Infrared Remote Controls

As mentioned throughout the article, the infrared receiver module will work with any "universal" style remote control. This type of remote can be programmed to work with hundreds of different devices. It's just a matter of selecting the appropriate device from the supplied list and punching in the matching code per the instructions.

The receiver module masquerades as a Philips brand appliance. Although many different manufacturers use the Philips infrared protocol (RC5), always try the Philips codes first. In order to work with the Girder group files that we've provided, you must choose a VCR code from the device list.

Unfortunately, no two universal remotes are alike when it comes to the function keys. Some have more keys than others and to confuse matters, key labelling differs even though the keys might transmit identical codes.

To make life much easier, we have preprogrammed the system to work with several readily available universal remotes, as follows:

(1) AIFA Y2E (Altronics A-1013) (use code 379);

(2) AIFA RA7 (Altronics A-1009) (use code 379);

(3) BC-3000 (Jaycar AR-1710) (use code 278).

We've also included support for the Sony Playstation remote. These are available at reasonable prices (especially the clones) and provide all the keys necessary to control a DVD player with ease.

Tables 1 & 2 list the functions we've assigned to the keys on these remotes. The universal models don't have enough keys to control all possible functions, so we've included a "shift" mode.

To control any function that requires a shifted key (listed with the "Shift-" prefix), make sure that shift mode in active (press the "Shift" key). For WinDVD, the shift state is toggled each time the "Shift" key is pressed. By contrast, shift is active for one key press only in Winamp.

Function	AIFA Key	BC3000 Key	Playstation Key
Power off (press twice)	PWR	PWR	Time
Open/Close	TV/AV	TV/AV	A<->B
Play	▶	▶	▶, Enter
Pause	⏸	⏸	⏸
Stop	■	■	■
Step	Shift- ⏸	Shift- ⏸	Slow ▶
Fast forward	⏩	⏩	Scan ⏩
Rewind	⏪	⏪	Scan ⏪
Instant replay			Repeat
Next chapter	Ch up	Ch up	Next ⏭
Previous chapter	Ch down	Ch down	Prev ⏮
Chapter (0 - 9)	0 - 9	0 - 9	0 - 9
Mute	12(Y2E), Mute 🔇	20+, Mute 🔇	X
Volume up	Vol +	Vol +	△
Volume down	Vol −	Vol −	□
Full screen/window	11	10+	○
Up	Shift- Ch up	Shift- Ch up	▲
Down	Shift- Ch down	Shift- Ch down	▼
Left	Shift- Vol −	Shift- Vol −	◀
Right	Shift- Vol +	Shift- Vol +	▶
Select	Shift- ▶, ▶	Shift- ▶, ▶	Enter, ▶
Main menu	Shift- ●	Shift- ●	DVD Menu
Resume			Return ↺
Bookmark	Memo (RA7)		Program
Brightness up	G (RA7)		R1
Brightness down	R (RA7)		R2
Angle selection			Angle
Audio selection			Audio
Title selection			Title
Subtitle selection			Subtitle
Return			Return
Up (pop-up menu)			L1
Down (pop-up menu)			L2
Enter (pop-up menu)			Select
Shift (toggle)	●	●	n/a

Table 1: WinDVD functions and the associated remote control keys.

Function	AIFA Key	BC3000 Key	Playstation Key
Power off (press twice)	PWR	PWR	Time
Open/Close	TV/AV	TV/AV	A<->B
Play	▶	▶	▶, Enter
Pause	⏸	⏸	⏸
Stop	■	■	■
Fast forward	⏩	⏩	Scan ⏩
Rewind	⏪	⏪	Scan ⏪
Next track	Ch up	Ch up	Next ⏭
Previous track	Ch down	Ch down	Prev ⏮
Track (0 - 9)	0 - 9	0 - 9	0 - 9
Mute	12(Y2E), Mute 🔇	20+, Mute 🔇	X
Volume up	Vol +	Vol +	△
Volume down	Vol −	Vol −	□
Next playlist	Shift- Ch up	Shift- Ch up	▲
Previous playlist	Shift- Ch down	Shift- Ch down	▼
Start playlist	n/a	n/a	Enter
Shuffle toggle			Shuffle
Repeat toggle			Repeat
Crossfade toggle			Audio
OSD toggle			Display
Shift (one-shot)	●	●	n/a

Table 2: Winamp functions and the associated remote control keys.

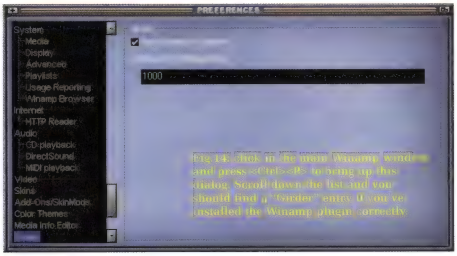


Fig.14: click in the main Winamp window and press <Ctrl><P> to bring up this dialog. Scroll down the list and you should find a "Girder" entry if you've installed the Winamp plugin correctly.

then it's not too difficult to change the key assignments.

To begin, make sure that both Winamp and WinDVD are closed. Next, open the Girder window and load the appropriate group file using the *File -> Open* menu command. In this example, we're assuming that you've loaded "Winamp3_RC5.GML"

On the left side of the window, you'll see a tree structure that looks a bit like a directory listing in Windows Explorer (Fig.8). Click on the "+" next to the "Winamp3" folder (top level group) to open it. The tree expands to show a number of folders (groups) underneath. Open the "Non-shifted" group to access all commands related to non-shifted keys.

Under the "Non-shifted" group you'll find the commands further subdivided into "General", "Volume" and "Track Select". Open the "General" group to see all the keys assigned to general commands, such as "Play", "Pause", etc.

Now click on the "Stop" command and in the bottom right of the Girder window, you'll see the action performed when this command is executed. Until you understand how Girder works, this probably won't mean much. However, you don't actually need to know how the command works to change the key assignment!

Next, click on the "+" next to the "Stop" command to open it. Below, you'll see an entry named "Eventstring". This entry contains the actual key code associated with the "Stop" key on your remote.

Click on the "EventString" entry to highlight it and the key code is displayed in large dot-matrix style characters on the right side of the window. To change this code, first make sure that the drop-down list at the top right of the window reads "All", then click on the "Learn Event" button.

Point your remote at the receiver and press the key you want to assign to the "Stop" command. Girder immediately updates the EventString entry with the received key code. Now save the updated group file by selecting the *File -> Save* command from the main menu. All done!

Of course, you probably wouldn't want to change the assignment of the "Stop" key – this was just a convenient choice for our example. Most other key assignments can be changed in a similar fashion. Always save a backup copy of a group file before modifying it, just in case!

Other uses

Your new infrared remote receiver is not limited to controlling just Winamp and WinDVD. If you're into programming and like a challenge, then you can program Girder to perform just about any task via remote control. Check out the on-line help at **www.girder.nl** for more information.

As a bonus, we've included support on the receiver board for applications that work with the Irman. This commercially available infrared receiver works with dozens of popular remote-enabled applications. To enable Irman compatibility, power off the receiver and install a jumper shunt on JP3.

For details on Irman and supported software, visit **www.evation.com/irman**

Note: jumper JP3 should only be installed if you specifically require Irman compatibility. Do not install it when using the module with Girder. Also, we have not tested the receiver with all Irman-enabled applications and can not guarantee that it will work in all cases.

The receiver module is also eminently suitable as an add-on to existing microcontroller projects. A simple two-wire serial interface is all that's required for the connection. Perhaps you'll be driving your next PICAXE project from your armchair!

Enjoy! **SC**

WinDVD has a simple easy-to-use interface but it's even easier via remote control.

Look at these amazing prices on pumps and solar garden lights

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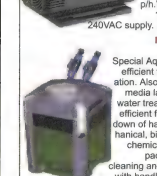

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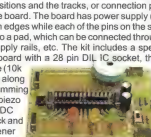

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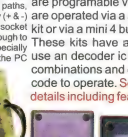

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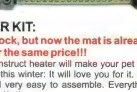

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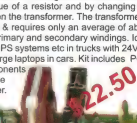

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- Suitable for use with a variety of sensors
- Use it to show fuel level, oil pressure or engine temperature
- Alarm output
- Display auto-dims at night

Digital Instrument Display For Cars

Based on a PIC microcontroller, this simple project lets you convert the analog instruments in your car to a digital display. It's suitable for use with fuel gauges, oil pressure gauges and temperature gauges, and even features an alarm output.

Pt.1: By JOHN CLARKE

IN THE PAST, SILICON CHIP has described an array of digital instruments for use in cars. These include a Speed Alert (with speedometer), a Tachometer, a Voltmeter, a Thermometer, an Ammeter and an Air/Fuel Mixture Display. However, that line-up by no means exhausts the potential for other digital readouts in a car.

For example, most cars have analog readouts for displaying fuel level and engine temperature. Similarly, the oil pressure is either shown on an analog gauge or more commonly, there's no gauge and just an "idiot" warning light instead.

Of course, there's nothing wrong with analog gauges – it's just that some drivers would rather have these outputs displayed in digital format instead.

That's where this Digital Instrument Display comes in – it's designed to operate with any sensor or sender unit which varies its resistance or voltage signal output and display the result on a 3-digit LED readout. Basically, it's ideal for use with sender units that have relatively slow changing values; eg, as found in fuel level, oil pressure and temperature gauges.

In operation, the unit can be calibrated so that the display will show any value in the range from -99 through to 999. The decimal point can be also be placed in one of two positions, so that the values can be from -.99 to 9.99 or from -9.9 to 99.9. In addition, the unit can be calibrated to display metric or imperial units.

Alternatively, the values do not need to relate to any particular unit and could refer to percentages instead – eg, 100% for full.

Of course, fuel and temperature gauges don't usually show precise values. Instead, they give a general indication of how things are going – eg,

remaining fuel level somewhere between full and half-empty, or temperature midway between hot and cold. By contrast, you can calibrate this digital display unit to show the actual values – eg, fuel remaining in litres (or gallons if you prefer) or engine temperature in °C or °F, or some other function.

In practice, the Digital Instrument Display is calibrated at two values and the instrument calculates the remaining values from these in a linear fashion. For example, if the unit is to be used as a fuel gauge, it is best calibrated when the fuel tank is full (eg, 55 litres fuel) and then calibrated when the tank is close to empty (eg, 10 litres). The display will then subsequently be able to show the remaining fuel in the tank (in litres) over the complete range from full to empty.

Alarm output

An alarm output is available to warn of impending "doom". For example, it could be set to trigger an alarm when the fuel tank approaches empty. Alternatively, it could be used to alert the driver if the engine is overheating or if the oil pressure is too low.

In operation, the unit is set up to trigger the alarm when the display reading goes above or below a particular value. Under alarm conditions, the righthand decimal point lights as a visual indication. In addition, the alarm output can also drive a low-current piezo siren if an audible indication is required or it can be used to trigger an external relay-driver circuit.

Presentation

As might be expected, this new unit matches the appearance of our previous digital instruments for cars. It's housed in a small plastic case, with the display showing through a transparent red Perspex or acrylic window.

There are no user controls on the front panel. Instead, the three calibration switches (Mode, Up & Down) are hidden behind the front panel as they are not needed once the unit has been calibrated.

Different modes

The Mode switch is used to display the calibration values. On the first press, the display initially goes blank and then shows the first calibration value. This value is initially set at 0 and can be changed to any number up to 999 (disregarding the decimal point) using the Up and Down switches.

Pressing the Mode switch again then brings up the second calibration value. This is initially set at 100 but again can be set to any number from 0-999 using the Up and Down switches.

Similarly, pressing the Mode switch a third time brings up the alarm value and once more, this is adjusted using the Up and Down switches. The sense of the alarm can also be set – ie, so that it is either on for values above the alarm setting (and off for values below this) or on for values below the alarm setting.

The required alarm sense is selected at power up. Pressing the Mode switch when power is first applied will keep the display blank and upon release the display will show either AL or AL-. An "AL" display indicates that the alarm will be on for values above the alarm value and off for values below the alarm value. Conversely, an "AL-" display indicates that the alarm will be off for values over the alarm setting and on for values below this.

To change from one to the other, you simply switch off the power and then hold down the Mode switch and apply power again. The display will now show the alternative setting when the switch is released.

Returning now to the normal Mode switch operation, the fourth press of this button displays the actual measured value of the voltage applied to the input of the unit. This is to allow the unit to be set up correctly – ie, it allows you to ensure that the applied input voltage is within the permissible range.

The fifth pressing of the Mode switch brings up three dashes (- - -) for a short period, after which the unit returns to the "normal" display mode. In this mode, it displays the calculated value, which is based on the input voltage and calibration values. In this mode, the alarm LED will either be lit or unlit, depending on the alarm setting and the input signal level.

In summary, at power up, the display is in its normal mode. Repeatedly pressing the Mode switch then brings up the following modes: 1 – First Calibration Value; 2 – Second Calibration Value; 3 – Alarm Threshold; 4 – Measured Input Level; and 5 – Normal Mode again. Modes 1-4 are all indicated with a flashing alarm LED.

Circuit details

Fig.1 shows the circuit for the Digital Instrument Display. It's dominated by IC1, a PIC16F84-10P microcontroller. This monitors the input signal voltage via comparator stage IC2a, processes the information and drives the three 7-segment LED displays (DISP1-DISP3).

And yes, it's all very similar to our previously published digital car instruments. That's the beauty of using a PIC processor – we can use similar circuitry but get it to do what we want by writing new software to control the device.

OK, let's start with the input sensing circuit. In operation, the incoming analog signal from the sensor (or sender) is filtered using a 10kΩ resis-

MAIN FEATURES

- Suitable for connection to variable resistance or voltage output sensors.
- Programmable display values; shows readout on a 3-digit LED display.
- Alarm output signal with visual alarm output indication at righthand decimal point.
- Adjustable alarm level.
- Can be set to alarm either above or below set value (optional).
- Displays values from 999 maximum to -99 minimum.
- Decimal point selection at x.xx or xx.x position (optional).
- Automatic display dimming in low light levels.
- 2-second display update period.

Parts List

1 Microcontroller PC board, code 05108031, 78 x 50mm
1 Display PC board, code 05108032, 78 x 50mm
1 front panel label 80 x 53mm
1 plastic case utility case measuring 83 x 54 x 30mm
1 Perspex or Acrylic transparent red sheet, 56 x 20 x 3mm
1 10MHz parallel resonant crystal (X1)
1 LDR (Jaycar RD-3480 or equivalent) (LDR1)
3 SPST micro tactile switches (Jaycar SP-0600 or equivalent) (S1-S3)
5 PC stakes
3 7-way pin head launchers
1 DIP18 socket for IC1
2 DIP14 low cost IC sockets with wiper contacts (cut for 3 x 7-way single in line socket)

Screws & spacers

1 9mm long x 3mm ID untapped brass spacer
1 10mm long x 3mm ID tapped Nylon spacer (can be made from 2 x 6mm spacers with one cut to 4mm)
2 6mm long M3 tapped Nylon spacers
2 M3 x 6mm screws
1 M3 x 15mm brass screw
1 M3 x 15mm Nylon screw

Wire & cable

1 300mm length of 0.7mm tinned copper wire
1 2m length of red automotive wire
1 2m length of yellow automotive wire
1 2m length of black or green automotive wire (ground wire)

Semiconductors

1 PIC16F84-10P or PIC16F84-20P microcontroller programmed with INSTRUM.HEX (IC1)
1 LM358 dual op amp (IC2)
1 7805 5V 1A 3-terminal regulator (REG1)
3 BC327 PNP transistors (Q1-Q3)
1 BC547 NPN transistor (Q4)
2 BC337 NPN transistors (Q5,Q6)
3 HDSP5301, LTS542A common anode 7-segment LED displays (DISP1-DISP3)
1 3mm red LED (LED1)
1 LM336-2.5 reference diode (REF1)
1 16V 1W zener diode (ZD1)
4 1N914 switching diodes (D1-D4)

Capacitors

2 100µF16VW PC electrolytic
3 10µF 16VW PC electrolytic
1 390nF (0.39µF) MKT polyester
2 100nF (0.1µF) MKT polyester
2 18pF ceramic

Trimpots

1 20kΩ horizontal trimpot (code 203) (VR1)
1 250kΩ horizontal trimpot (code 254) (VR2)
1 500kΩ horizontal trimpot (code 504) (VR3)

Resistors (0.25W, 1%)

1 1MΩ	1 1kΩ 0.5W
1 200kΩ	3 680Ω
7 10kΩ	9 150Ω
2 3.3kΩ	1 10Ω 1W

Miscellaneous

Automotive connectors, heat-shrink tubing, cable ties, etc.

tor and 100µF capacitor and fed to pin 2 of comparator stage IC2a. Note that provision has been made for a pullup resistor directly at the input, since this will be necessary with some sensors. Similarly, resistor R2 can be used to attenuate the input signal if necessary (more on this later).

In operation, IC2a compares the voltage on its pin 2 input with a DC voltage on its pin 3 input. This DC voltage is derived by applying a pulse-width modulated (PWM) square-wave signal from the RA3 output of IC1 to a 390nF capacitor via a 200kΩ resistor and trimpot VR2.

As a result, pin 1 of IC2a switches low when ever the voltage on its pin 2 input is greater than the voltage on pin 3. This signal is then fed via a 3.3kΩ limiting resistor to the RB0 input of IC1. This resistor limits the current from IC2a when its output switches high to a nominal 12V, while internal clamp diodes at RB0 limit the voltage on this pin to 5.5V.

A-D converter

Among other thing, IC1 functions as an analog-to-digital (A-D) converter. In operation, it converts the comparator signal on its RB0 (pin 6) input to a digital value which is then used to drive the 3-digit LED display.

The A-D converter used here operates by using a series of successive approximations and involves just two external connections to IC1. As mentioned above, IC1 produces a PWM signal at its RA3 output and this operates at 4.882kHz with a wide-ranging duty cycle. Note that a high output from RA3 is at 5V while a low output is at 0V.

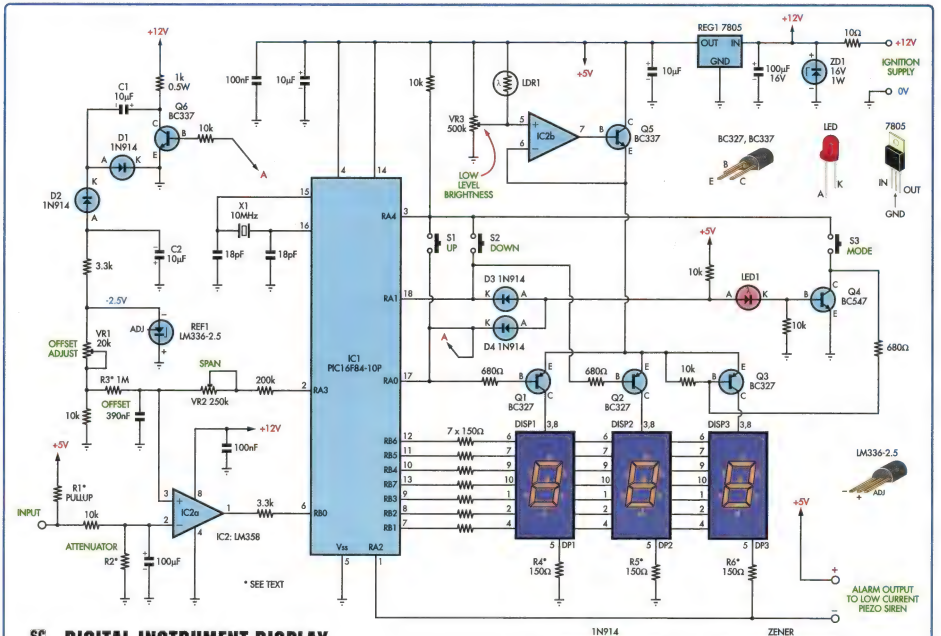
The RC network on RA3 filters this PWM waveform to derive a DC voltage that is the average of the PWM waveform. This means that if the duty cycle is 50% (ie, a square wave), the average at RA3 will be 50% of 5V or 2.5V. Varying the duty-cycle either side of 50% produces higher or lower DC voltages accordingly.

Operation of the A-D converter is as follows: initially, the RA3 output is set to a 50% duty cycle and this sets the voltage at pin 3 of IC2a at 2.5V. At the same time, an 8-bit register inside IC1 has its most significant bit set high so that its value will be 10000000.

During this process, the comparator's output is monitored by IC1's RB0 input. If the measured voltage is lower than 2.5V, IC2a's output is high and the PWM output at RA3 is reduced to a 25% duty cycle to produce an average of 1.25V. The internal register is now set to 01000000.

Alternatively, if the measured voltage is above 2.5V, corresponding to a low comparator output, the RA3 output is increased to a 75% duty cycle to provide an average of 3.75V. The register is thus set to 11000000, with the most significant bit indicating a 2.5V 50% duty cycle and the next bit indicating the 1.25V 25% duty cycle (adding the two bits gives us the 3.75V).

The comparator output is again checked, after which the microcontroller adds or subtracts a 12.5% duty cycle (0.625V) and compares this against the input voltage again. The register is then set to X1100000 (with X a 1 or 0 as determined by the previous operation) if the input voltage is



DIGITAL INSTRUMENT DISPLAY

Fig.1: the PIC microcontroller (IC1) does most of the work in this circuit. It accepts inputs from the sensor (via IC2a) and drives three 7-segment LED displays.

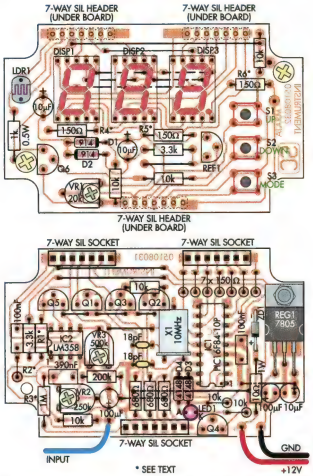


Fig.2: install the parts on the PC boards as shown here . In particular, be sure to install the 7-segment LED displays with their decimal points at bottom tight and take care not to get the transistor types mixed up.

higher than the PWM waveform.

Conversely, if the input voltage is lower than the PWM voltage, the register is set to X0100000.

This process continues for eight cycles, the microcontroller progressively adding or subtracting smaller amounts of voltage (ie, 0.312V, 0.156V, 0.078V, 0.039V and 0.0195V) and the lower bits in the 8-bit register being either set to a "1" or a "0" to obtain an 8-bit A-D conversion.

Further resolution is obtained by altering the counter that's used to generate the PWM output. By adding or subtracting a number to the count, we can alter the filtered PWM signal by a small amount – corresponding to 9.76mV, 4.88mV and 2.44mV – so that we obtain an 11-bit A-D conversion.

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
390nF	0.39µF	394	390n
100nF	0.1µF	104	100n
18pF	18pF	18	18p

The A-D conversion thus has a resolution of around 2.44mV at the least significant bit. The possible number of values for the 11-bit register is from 00000000000 (0) to 11111111111 (2048).

In practice, we are limited to a range from about 152 to 1848 because the software must have time for internal processing to produce the waveform at the RA3 output. This means that the input signal can only be measured over a particular range of voltage corresponding to the 152 minimum count and the 1848 maximum count.

This corresponds to about 373mV minimum and 4.5V maximum.

However, it's quite common for automotive sensors to produce signals all the way down to 0V, so we need to cater for this type of sensor. That's done by applying a negative voltage to pin 3 of IC2a, to offset the 375mV minimum from the A-D converter.

This offset voltage is derived from voltage reference REF1, diodes D1 & D2 and transistor Q6 and its associated components.

Q6 is driven by the RA0 output of IC1. When the RA0 output is low, Q6 is off and capacitor C1 charges via a 1kΩ resistor (which connects to the 12V supply) and via diode D1. When the RA0 output subsequently goes high, Q6 turns on and connects the positive side of C1 to ground. As a result, the other end of C1 goes negative and this charges capacitor C2 via diode D2.

C1 is again charged when Q6 turns

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	1	200kΩ	red black yellow brown	red black black orange brown
❑	7	10kΩ	brown black orange brown	brown black black red brown
❑	2	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	3	680Ω	blue grey brown brown	blue grey black black brown
❑	9	150Ω	brown green brown brown	brown green black black brown
❑	1	10Ω	brown black black brown	brown black black gold brown

off, while D2 now becomes reverse biased and prevents C2 from discharging via this path. Instead, the negative voltage across C2 is applied to voltage reference diode REF1 via a 3.3kΩ resistor to produce a fixed -2.49V reference voltage, This voltage is then applied to pin 3 of IC2a via VR1, a 10kΩ resistor and a 1MΩ resistor (R3).

In practice, VR1 is adjusted so that the applied voltage offsets the 390mV minimum output from the A-D converter.

LED displays

The 7-segment display data from IC1 appears at outputs RB1-RB7 and these directly drive the cathodes of the three LED displays (DISP1-3) via 150Ω current limiting resistors. Note that the segments common to each display are connected together – ie, the "a" segment cathodes are all connected together, as are the "b" segments and so on.

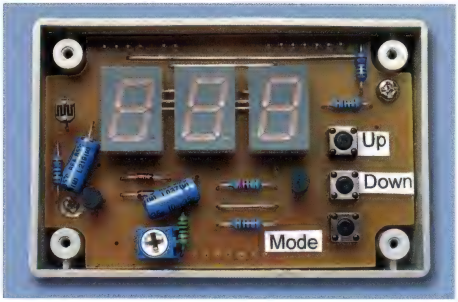
The displays are driven in multiplex fashion, with IC1 switching its RA0 & RA1 lines low in sequence to drive transistors Q1 & Q2. For example, when RA0 goes low, Q1 turns on and applies power to the common anode connection of DISP1. Any low outputs on RB1-RB7 will thus light the corresponding segments of that display.

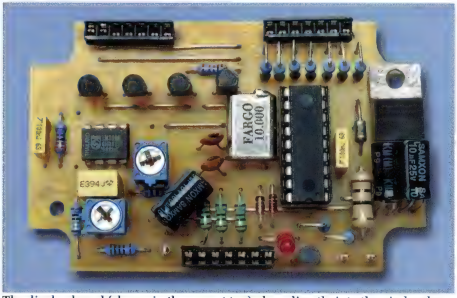
After this display has been on for a short time, the RA0 output is taken high and DISP1 turns off. The 7-segment data on RB1-RB7 is then updated, after which RA1 goes low to drive Q2 and display DISP2.

Transistor Q3, which switches power to DISP3, is driven in a different manner to Q1 & Q2. This transistor is off when ever either RA0 or RA1 is low (ie, if one of the other displays is on). That's because a low on RA0 or RA1 holds LED1's anode low (ie, at 0.6V) via either diode D4 or D3. As a result, LED1 cannot conduct and so Q4 is off.

However, when RA0 and RA1 are both high, D4 and D3 are reverse biased and Q4's base is pulled high via the 10kΩ resistor on LED1's anode. This turns Q4 on which in turn pulls Q3's base low via a 680Ω resistor. And that, in turn, turns Q3 on and lights display DISP3.

Of course, in practice, DISP1, DISP2 & DISP3 are switched on and off at a very fast rate, so that they appear to be continuously lit.





The display board (shown in the case at top) plugs directly into the pin header sockets on the processor board (above), eliminating wiring connections between the two. Notice how the electrolytic capacitors on the two boards are bent over (see text), to prevent them fouling other parts.

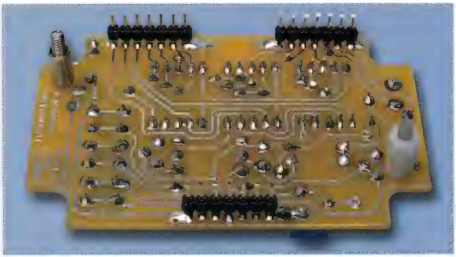
Finally, note that the decimal point (pin 5) of DISP3 is connected to IC1's RA2 output. RA2 is the alarm output and it normally switches low and turns on DP3 under alarm conditions. It can also be used to activate a low-current piezo siren which has its other side connected to the +5V rail.

Display dimming

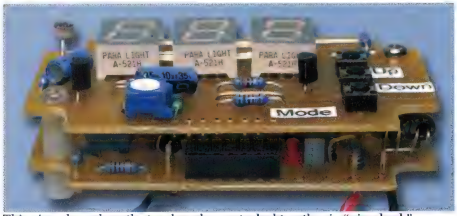
Op amp IC2b is used to control the display brightness. This stage is wired as a unity gain amplifier and drives transistor buffer stage Q5 which is inside the negative feedback loop.

Light dependent resistor LDR1 varies the voltage on pin 5 of IC2b according to the ambient light level. In daylight, the voltage on pin 5 (and thus on pin 7) is close to +5V because the resistance of the LDR is low. This means that Q5's emitter will also be close to +5V and so virtually the full supply rail is applied to the emitters of transistors Q1-Q3 and the displays operate at full brightness.

As the ambient light falls, the LDR's resistance increases and so the voltage on pin 5 of IC2b decreases. And when it's completely dark, the voltage on pin 5 is determined by the setting of trimpot VR3 which sets the minimum brightness level. As before, the voltage on pin 5 appears at Q4's emit-



The pin headers are installed on the track side of the display board using a fine-tipped soldering iron. Note that it will be necessary to slide the plastic spacers along the leads to allow room for soldering.



This view shows how the two boards are stacked together in "piggyback" fashion to make a compact assembly. Make sure that none of the parts on the processor board contact the back of the display board.

ter and so the displays operate with reduced brightness.

Mode switches

Switches S1-S3 are all monitored using the RA4 input which is normally at 5V due to a 10kΩ pullup resistor. The other sides of S1 and S2 are connected to the RA0 and RA1 outputs respectively, while S3 connects to Q4's collector.

This means that pressing S1 will pull RA4 low when RA0 is low. Similarly, S2 can pull RA4 low when RA1 is low, while S3 can pull RA4 low when both RA0 and RA1 are high. As a result, the microcontroller can determine which switch has been pressed when RA4 goes low, by checking the status of both RA0 and RA1.

Clock signals

Clock signals for IC1 are provided by an internal oscillator circuit which operates in with crystal X1 (10MHz) and two 18pF capacitors. The two capacitors provide the correct loading for the crystal and ensure that the oscillator starts reliably.

The crystal frequency is divided down internally to produce clock signals for the microcontroller operation and for the display multiplexing.

Power

Power for the circuit is derived from the vehicle's ignition supply line. A 10Ω 1W resistor and a 100µF capacitor decouple this supply line, while 16V zener diode ZD1 protects the circuit against transient voltage spikes.

The decoupled ignition supply is then fed to regulator REG1 which provides a +5V rail. This rail is then used to power the microcontroller and display circuitry, while IC2 and Q6 are powered directly from the decoupled ignition supply.

OK, that completes the circuit description. Of course, most of the clever stuff takes place inside the PIC microcontroller under software control. You can download the source code (instrum.asm) from the SILICON CHIP website if you want to figure out how it works. The source code is fully commented, so you shouldn't have too much trouble.

Construction

All the parts are mounted on two PC boards: (1) a microcontroller board coded 05108031, and (2) a display PC board coded 05108032. These boards are stacked together using pin headers and sockets to make the interconnections, so there's no external wiring (apart from the power supply and sensor connections).

Fig.2 shows the assembly details. Begin construction by checking the PC boards for shorts between tracks and possible breaks and undrilled holes. That done, install all the wire links on both PC boards. It is important that these be installed now, since other parts mount over the top of some of these links.

You can now concentrate on building the microcontroller board. Begin by installing all the resistors using Table 1 as a guide to determining the correct values. It's also a good idea to check them using a digital multimeter, just to make sure.

Note that some of the resistors including the 7 x 150Ω units at top right, are mounted end-on to save space. Leave out R1 and R2 for the time being but be sure to install R3 (1MΩ) as shown.

Next, install a socket for IC1 (taking care with its orientation), then install IC2, zener diode ZD1 and diodes D3 & D4. That done, install REG1 by bending its leads down by 90° so that its metal tab sits flat against the PC board. Make sure that the hole in the metal tab lines up with the hole in the PC board before soldering the leads.

Trimpots VR2 & VR3 can go in next (don't get them mixed up), followed by the capacitors. Note that the two electrolytic capacitors near the regulator must be mounted so that their bodies lie flat against REG1's leads (see photo). Similarly, the 100µF capacitor near VR2 must be mounted so that it lies between the adjacent 200kΩ and 680Ω resistors (see photo).

In practice, this simply involves

bending the capacitor leads down by 90° before installing them on the board. Note that the two electrolytic capacitors near REG1 are oriented in opposite directions.

Next, install three PC stakes at the external wiring points, then install the transistors. Q1-Q3 are all BC327s (PNP), while Q5 is a BC337 NPN type so don't get it mixed up with the others. The remaining transistor on this board (Q4) is a BC547.

Crystal X1 also mounts horizontally on the PC board. It is secured by soldering a short length of tinned copper wire between the end of its metal case and an adjacent PC pad.

Finally, the three 7-way in-line sockets can be fitted. These are made by cutting two 14-pin IC sockets into single in-line strips using a sharp knife or a fine-toothed hacksaw. Clean up the rough edges with a file before installing them on the microcontroller board.

Display board

Now for the display board. The wire links should already be in place but if not, install them now, followed by the resistors, diodes and trimpot VR1. **At this stage, you can also decide if you want the decimal point showing. Install R4 if the display is to show x.xx, or R5 if the display is to show xx.x instead. Alternatively, do not install either resistor if the decimal point is not required.**

Next, install the three 7-segment LED displays with their decimal points at bottom right. REF1, Q6 (BC337) and the two electrolytic capacitors can then be installed. As before, the two electrolytics are installed so that their bodies lie fat against the PC board.

The LDR is mounted so that its top face is about 3mm above the displays (it can go in either way). Install it now, followed by the three pushbutton switches.

Finally, complete the display board assembly by installing the pin headers. These are installed from the copper side of the board, with their pins protruding about 1mm above the top surface.

You will need a fine-tipped iron to solder these pin headers. Note that you will also have to slide the plastic spacers along the pins to give sufficient room for soldering.

Preparing the case

Work can now begin on the plastic case. First, use a sharp chisel to remove the integral side pillars, then slide the microcontroller board in place and use it as a template to drill two mounting holes in the base – one through the hole in REG1's tab and the other immediately to the left of R3.

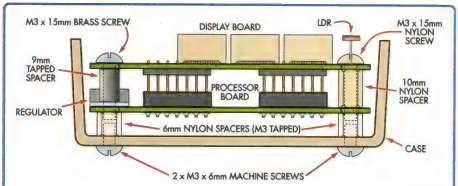


Fig.3: follow this diagram when stacking the boards together and be sure to use plastic spacers where indicated.

In addition, you will have to drill a hole in the back of the case to accept the power leads, plus an extra hole for the input signal lead.

Once that's done, plug the display board into the microcontroller board and secure them together using machine screws and spacers as shown in Fig.3. Check that the leads from the parts on the display board do not interfere with any parts on the microcontroller PC board. If necessary, trim the leads of the display board parts to prevent this.

The front panel artwork (to be published next month) can now be used as a template for making out the display cutout and the position of the hole for the LDR. That done, drill the LDR hole and drill a series of closely-space holes around the inside perimeter of the rectangle for the display cutout. The centre-piece can then be knocked out and the job filed to a smooth finish.

Be sure to make the cutout just large enough, so that the red Perspex or acrylic window is a tight fit. This window can then be further secured by applying several small dabs of super glue along the inside edges.

Testing

It is best to check the power supply before plugging the microcontroller IC into its socket.

To do this, first unplug the display board and put it to one side. That done, connect the +12V and GND leads to the microcontroller board, apply power and use a multimeter to check that there is +5V on pins 4 & 14 of IC1's socket (use REG1's metal tab for the GND connection).

If this is correct, disconnect power and insert IC1 in place, ensuring that it is oriented correctly. That done, plug the display board back in and apply power with the input lead connected to ground. The display should light and show three dashes (- - -). After about two seconds, the display should then show a number. Our prototype showed -4, but this will depend on the settings of VR1 and VR2.

Now press the Mode switch – the display should now show "0" and the alarm LED should flash. Pressing the Mode switch again should now cause the display to show "100". Press it again and the display should show 50, while the fourth press should bring up the current input reading.

Our prototype showed 97 but this will again depend on the settings for VR1 and VR2.

Now test the dimming feature by holding your finger over the LDR. Adjust VR1 until the display dims. Note: this trimpot is best adjusted in the dark to set the minimum brightness.

Finally, check that there is -2.5V at the negative terminal of voltage reference REF1. Note, however, that this voltage could vary from this value by about 200mV due to tolerances in the reference.

That's all we have space for this month. In Pt.2 next month, we will describe how to connect different sensors to the unit and describe the calibration procedure for these various sensors. **SC**

The Downpipe waveguide antenna mounted on a standard TV mast. Due to increased wind loading, guy-wires are used for stability.

Homebrew Weatherproof 2.4GHz WiFi Antennas

In the Nov 2002 SILICON CHIP, Stan Swan introduced us to the 'art' of making your own microwave antenna for 2.4 GHz (WiFi) networking, using a readily available 'kipper can' and a piece of bent wire. There are many homebrew microwave antenna designs available on the Internet; not all of which are weatherproof. This article shows how to make two, high performance, weatherproof WiFi antennas using readily available materials and common garage tools.

We're going to show you how to build two antennas – the Downpipe Antenna and the AntCap Antenna.

Now just in case the significance of those names has been lost on you, the ***Downpipe Antenna*** is a wide-beam antenna that is suitable for use at the center of a wireless network and is, in fact, made from a length of downpipe.

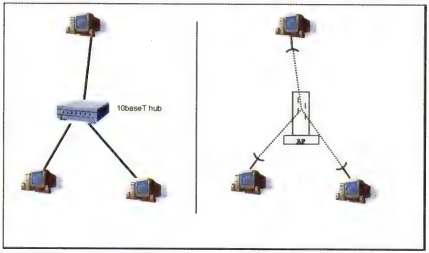
The ***AntCap Antenna*** is, suprisingly enough, made from (you guessed it!) an ant cap. It is a narrow-beam antenna used to connect to either another AntCap (for a point-to-point link), or to a *Downpipe* antenna.

by ROB CLARK

A Quick Review of WiFi Networks

The most common WiFi standard in use today is 802.11b, which specifies a 2.4GHz carrier, and a nominal 11Mbps data transfer rate.

The technology is undergoing explosive growth and development which will make 802.11b obsolete very soon but new standards continue to use the same 2.4GHz frequencies so the antennas described in this article



802.11b Networks resemble hub-based wired networks

will work equally as well.

Most WiFi networks resemble old 10baseT networks, which had a 10Mbps hub, with all the computers connected into the hub.

These networks were collision-based – so Ethernet packets sent simultaneously, would often collide and be resent. It can be mathematically shown that collision-based, 802.11-style networks have an effective upper limit on data traffic of 30% of the nominal speed.

So, 10BaseT, hub-based networks saturated at 3Mbps. 802.11b networks are virtually identical, except the hub is replaced with an antenna and an Access Point (AP) and the computers have an antenna and some sort of wireless ethernet interface.

The *Downpipe* wide-beam antenna

At the center of a WiFi network, there is generally an Access Point (AP) with a wide-beam antenna. APs usually come with a short stub antenna (or two) which are have a low performance ('gain'), adequate for distances up to 100m.

If you want to have a network that spans kilometres, you will need a higher gain, external antenna. The *Downpipe* is such an antenna.

How does it work?

If you cast your mind back to those physics lessons at school that you slept through, you may remember something about organ pipe theory and resonance.

Well, that is the secret to the Downpipe! It is effectively a resonant pipe for 2.4GHz electromagnetic waves (fed into the pipe by a short stub antenna), which 'leaks' energy out the slots. The slots are spaced so that the leaked energy is in-phase and so that the impedance is 50Ω.

That is pretty much all there is to it. The magic is working out where to place the slots. In fact each slot is half a wavelength from the next and the offset from the centre defines the impedance of each slot.

Parts List – Downpipe Antenna

1 2m length (approx) 95mm x 45mm ZincAlume downpipe.
1 40mm length 1.5-2mm dia. solid copper wire
1 tube caulking compound
1 roll UV-stabilized, microwave-transparent tape. 50mm wide. (Norton Part Number AT232297 Cat No. 725 Barcode: 9310357501190)
2 V-Clamps, for mounting (Jaycar Cat LT-3235)
1 3mm (1/8") aluminium pop rivet
1 Female-pin N-connector, panel mount, screw-type. (LINK Connectors Part: B30-005. See: www.gordontech.com.au)

If you cut slots in one face, you get an antenna that radiates in a nominal 180° arc. If the slots are cut in both faces, you get a nominal 360° beam pattern – but the signal strength is 50% (3dB) lower. (In reality, the beam is not uniform in all directions and the purists will call these Sector Antennas, as they radiate mainly in an 80° beam from each face.)

The nominal gain of a single-side, 8-slot *Downpipe* is 14dBi. A 2-sided, 16-slot *Downpipe* is 11dBi.

Before we start . . .

First of all, you'll need the following tools:

1. Electric router, with 6.5mm bit, or Nibbling tool (hand operated, or electric) (eg Altronics Cat T2355)
2. Hacksaw
3. Rivet gun
4. Drill, with 3mm (1/8") bit
5. Set Square (for nice 90° faces)

And you will also need software to calculate the resonant frequency and wavelength.

You can download an Excel file which will do it all for you:

www.erlang-software.com/FreeNet/Waveguide/WaveguideCalculator.zip

The *Downpipe* antenna radiates, and receives, RF energy through specially spaced slots. A length (or lengths) of UV-stabilised, microwave-transparent tape over the slots helps prevent little critters (spiders, ants, bugs, etc) taking up residence inside the antenna!

Scale drawing of a Downpipe antenna on 2.437GHz. The 10mm U-bolt mounting holes are on the "back" face.

Let's make one!

1. Check size.
Note that while the downpipe has a nominal size, it is manufactured so that one end witha taper fits inside the next. The material will either slowly change size from one end to the other, or will be deformed at one end.

2. Select squarest end.
Decide from which end you will work. The one with the straightest cut is a good choice. Mark **TOP** with a marking pen.

3. Measure and mark pipe.
Mark **"BOTTOM"** at the **approximate** location of the bottom of the air column. This is approx. 815mm from the TOP.

4. Workout the average large ID of the air column.
Take a few OD measurements between TOP and BOTTOM. Decide where a good average point would be. Measure the **Average OD** (e.g. 95mm). Measure the material thickness (e.g. 0.4mm). Calculate the **Ave ID** as (**Ave OD**) - (2 x **thickness**) (e.g. 95 - 2 x 0.4 = 94.2 mm)

5. Calculate your resonant frequency wavelength.
Using the Excel file which you downloaded earlier, select the *"Wavelength Calculator"* tab and enter the Ave. ID in the **Large ID** cell shown.
Note the calculated **Lg** (your wavelength), and **Small ID**. Confirm that your tubing has a small ID that is LESS than the number calculated.

6. Calculate the Dimensions for your antenna.
Select the *Antenna Dimensions* tab in the Excel file. The wavelength (**Lg**) calculated in the step above should be automatically transferred to the correct cells in this spreadsheet.
Table 1 shows an example set of calculations for 94mm (ID) downpipe, tuned to Channel 6.

7. Square-off the Top end.
If necessary (ie, if you didn't use the square-cut end thoughtfully provided by the manufacturer!), use a set square and a file/grinder to get a perfectly square top.

8. Mark and cut your downpipe.
Using the *Antenna Dimensions* spreadsheet determine the TOTAL LENGTH value and mark then cut your downpipe to this length (eg approx 900-920mm for an 8-slot antenna).

9. Mark the position of all slots.

Waveguide Antenna Dimensions (mm)

ID (mm)		94
Freq (GHz)		2.437
Antenna (slots)	8 + 0	8 + 8
Beam (deg)	180	360

Wavelength	(Lg)	162.7
Air Column		813.4
Mounting		100
Total Length		913

Slot			
	Length	57.8	
	Width	6.5	
	Offset from centre line		
	Inside Edge	9.6	5.8
	Centre	12.9	9.1
	Outside Edge	16.2	12.4

N Connector	
from bottom reflector	40.7
from top reflector	772.7
Offset from centre line	0

Slot (from top of airspace)	TOP	BOTTOM
1	11.8	69.6
2	93.1	150.9
3	174.4	232.3
4	255.8	313.6
5	337.1	394.9
6	418.5	476.3
7	499.8	557.6
8	581.1	639.0

This table shows the dimensions of the antenna drawing at left, as calculated by the Waveguide Calculator Excel spreadsheet software. For different frequencies and antenna types it's just a matter of plugging in the appropriate data.

Cut the 6.5mm slots with your router or nibbling tool. If making a 360° antenna, the slots on the back are positioned such that you can see through both slots from front-to-back.

10. Mount the N-Connector.
Mark the position. Drill and mount temporarily. Remove.

11. Make the feed.
Solder a length of copper wire into the solder bucket of the N-connector. Cut so the length of the copper wire extends 31mm from the end of the metal shield of the N-connector.

12. Cut the bottom-reflector mounting slots.
Mark the bottom of the Air Column on the SMALL sides (only). Use a hacksaw to cut through the SMALL SIDES ONLY of the antenna at the bottom of the air column. The two resulting slots will be the thickness of the hacksaw blade.

13. Make the Bottom reflector.
Use an off cut to make an L-shaped reflector, which slides through the two slots (step above). It should protrude about 1 mm on the far side.

14. Drill hole for rivet. Drill a hole for the rivet so that the bottom reflector will be held in place. Note: Keep the reflector as flat/straight as possible, to maintain antenna performance. DO NOT RIVET IN PLACE YET.

15. Make the Top reflector cap.
Use an off-cut to make a 'cap' that fits neatly over the top of the antenna. Note: Keep the reflector as flat/straight as possible, to maintain antenna performance.

16. Drill V-clamp mounting holes. These holes go in the bottom 100 mm section below the reflector, on the face with the folded metal seam. See the mounting section of the to-scale drawing for details.

17. Clean all metal swarf from inside the antenna.

18. Mount the N-Connector/Feed assembly. Caulk around edges to make waterproof.

19. Attach Bottom Reflector.
Slide bottom reflector in place, and rivet on one side. Caulk around the two slots to make waterproof. Do not waterproof the inside edges of the bottom reflector. You want any condensed water (or rain) to escape.

20. Attach Top Reflector cap.
Do not rivet... as you don't want protrusions inside the antenna cavity. The top reflector is held in place by the UV-tape in the next step.

21. Cover slots, and top reflector, with UV-tape.

The Law

The Australian Communications Authority (ACA, www.aca.gov.au) is responsible for the laws in Australia for this technology. In the frequency band used by 2.4GHz WiFi equipment (2.400- 2.484GHz), the bottom line is that you do not need a licence if:

- You are using DSSS (Spread Spectrum) equipment. (802.11b is DSSS).
- Your EIRP is less than 4W

Are you allowed to pass internet traffic over a neighbourhood WiFi network?

While it has not been tested in courts, the current interpretation of the laws is that you can only carry internet traffic for a fee if you have a Carrier License.

But – it appears legal to extend an internet connection within the 'same organisation' so long as there is no fee.

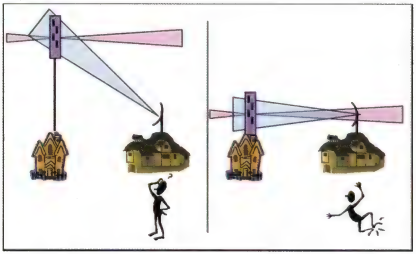
Of course **copyright laws apply** – regardless of what medium is used to pass a copyright protected work, such as music or video.

Installation

The Downpipe antenna gets its gain by compressing the beam into a very flat, pizza shape; generally aimed at the horizon.

That is great if the other antennas wishing to connect to the Downpipe are at the same elevation (height), but can cause problems if the Downpipe is mounted way above the other antennas.

Usually it is best to mount a Downpipe at the height of the nearby roof-tops. Alternatively, you might consider two 180° Downpipes mounted such that they are tilted down a bit.



Downpipe antennas have thin, horizontal beams. Mounting them high is not always ideal.

V-clamps hold the Downpipe securely to a suitable pole/mast.

The *AntCap* narrow-beam antenna

If you want to make a point-to-point WiFi link, or just connect to your neighbourhood AP, you need a narrow-beam (directional) antenna.

There are many designs on the Internet but not all are weatherproof, or include pole-mounting brackets. The *AntCap* has both features!

By the way, you will notice that the *AntCap* is really nothing more than a waterproof version of Stan Swan's Kipper Can antenna, which is itself an implementation of the standard 'BiQuad' antenna. We trust Stan will not mind.

How does it work?

The radiating element is a simply a pair of loops; each one-wavelength in circumference. The diagrams below show how it works.

Imagine a wave traveling around each loop, and imagine the wave crest being indicated with a "**+**", a wave valley with a "**-**", and the zero-crossing points with a "**0**".

Each diagram is a snapshot, a quarter of a wave period later in time than the previous. Where the fields line up, they are shaded red for "**+**", and blue for "**-**".

As you can see, with the feed oriented as shown, the signal appears to oscillate in a horizontal fashion. This antenna is horizontally polarized.

Next, we add a back reflector one eighth of a wavelength behind the feed, so that all the energy is radiated in the same direction and we have an antenna of about 12dBi gain.

Let's make one

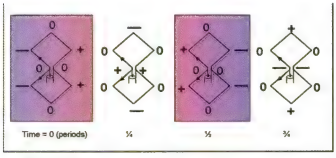
The tools you'll need for this antenna include:

- Drill
- Drill bits
- Screwdriver
- Soldering iron
- Rivet gun
- RG58 Crimping tool

The first thing to realise is that we only need to weatherproof the BiQuad feed, not the reflector.

While it would not particularly matter if the back reflector did rust, many hardware stores (in Australia!) sell ready-made, galvanized antcaps for stopping white ants (termites) coming up the stumps or piers and into the house timbers . . . perfect for a homebrew microwave antenna!

And if your hardware store does not sell antcaps, it's easy enough to make your own from a piece of light weight Zincalume or galvanized sheet steel.



As the wave travels around the loops, the signal appears to move from side to side

Side-on view of the AntCap antenna showing both front and rear. Construction is very simple – basically it's just a single PC board (the actual antenna) inside a weather-proof case, fastened to an antcap (the reflector) with a V-block/U-bolt mounting assembly on the rear.

Step-by-step

1. Mark center of ant cap.
2. Place short arm of Bracket against the back of the ant-cap, with center hole lined up with the center of the antcap, and aligned 'square' with the edges of the ant-cap. Drill four holes to suit your rivets. Note: The bracket purchased from Bunnings has four small and one large hole pre-drilled on each face.
3. Drill two holes on long arm of bracket to suit your V-clamp.
4. Rivet bracket to ant-cap.
5. Place enclosure base over the center of the front of the

An *AntCap* with the cover removed showing the BiQuad feed PC board inside the weatherproof box.

Parts List – AntCap Antenna

1 AntCap 125 x 125 x 50mm (Bunnings 1079234)
1 "Angle-Pergola" Bracket 88 x 63 x 36mm (Bunnings 1071032)
1 BiQuad PC board, 55 x 98mm, coded SC06108031
4 M4x20 screws (Bunnings 643277 [pack of 20])
4 1/4" spring washer, 1mm thick (Bunnings 2446511 [pack of 50])
1 V-Clamp, for mounting (Jaycar LT-3235)
4 1/8" or 3mm rivets
1 Tube of flexible, waterproof caulk
1 IP65-rated enclosure, 115 x 64 x 40 (Jaycar HB-6122)
4 M3 x 25 Nylon screws (Jaycar HP-0142)
4 M3 Nylon nuts (Jaycar HP-0146)
2 M3 x 20 Nylon spacer (Altronics H-1327 [pack of 100])
1 N connector, jack, RG58, crimp (see **www.gordontech.com.au** Part No. B30-330C)
1 0.4m length RG58-9006 low loss external coax (Rob Clark **www.erlang-software.com/FreeNet**)

And here's a front-on view showing how the box containing the antenna PC board is fixed in the exact centre of the ant cap. This antenna has a narrow beam.

ant cap. Align enclosure to be 'square' with the ant-cap.

6. Drill four 4mm dia holes (one in each corner of the enclosure) through the ant cap
7. Rotate enclosure 90°. Drill four more holes at corners.
8. Locate the top-half of the enclosure. The top has four brass mounting nuts embedded in the plastic (these are NOT the ones at the corners; they are 'inside' the enclosure.
9. Using a hot soldering iron, remove and throw away each of these embedded nuts. Insert soldering iron into the nut, and gently rotate it out as the plastic starts to melt.
10. Insert the supplied gasket into the groove in the enclosure. The gasket is too long; cut as needed.

The PC board removed from the box, showing how simply the coaxial cable connects to each dipole.

11. Drill two small (!!) holes in the PCB. Each hole goes near the center of the two short parallel tracks, near the center of the BiQuad. These holes are for the Coax connection
12. Drill 4 x 3mm holes in the PC board as follows: 15mm either side of the center axis, and inline with the 'top' and 'bottom' points of the BiQuad. (See figure)
13. Assemble the N-connector onto one end of the coax cable.
14. Locate the base of the enclosure. The base has the groove for the gasket. Drill a 5mm hole in one of the 64 x 40mm faces.
15. Remove 5mm of external insulation of other end of 9006 coax. Separate and fold back the shield. Remove 4mm of internal insulation. Twist the shield so that it resembles a piece of wire than can go through one of the small holes in the PC board. You may have to use only 50% of the shield wire or it ends up too thick. Solder the shield braid together to form the 'wire'.
16. Cut the spacers so that you have four pieces, each 8.5mm long. NOTE: The objective is to have the BiQuad 15mm from the antcap (reflector). Using the parts specified here, the spacing is:

Head of nylon screw:	2mm
Thickness of enclosure wall:	3mm
Spacer:	8.5mm
Thickness of PC board:	1.5mm
Total:	15mm

If you are using different size components, adjust the spacer length as needed.

17. Cut corners of PC board as needed to fit into bottom of enclosure
18. With PC board centered in the bottom of the enclosure, drill four 3mm holes through the bottom of the enclosure
19. Assemble PC board into enclosure using: four nylon screws, four spacers, PC board, and four nylon Nuts. Check that the PC board sits 'flat'. Remove four nylon

References and URLS:

www.erlang-software.com/FreeNet
More antenna information and designs by the author, including the 6dBi *Brick* antenna, and the 29 dBi *Satenna*.

www.nodedb.com/australia
List of FreeNet nodes in Australia

www.qsl.net/n1bwt/contents.htm Online Microwave Antenna Book

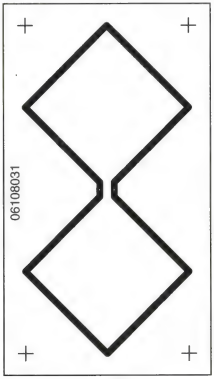
melbourne.wireless.org.au/tib Cheap WiFi parts

www.aca.gov.au/aca_home/legislation/radcomm/acts/radcom/spread_2002.pdf
The official word on licensing of WiFi (Spread Spectrum) equipment in Australia

nuts, and PC board.

20. Thread the un-terminated end of the coax through the 5mm hole in the side of the enclosure.
21. Pass the ends of the 9006 coax through the two small holes in the PCB. The solder-side of the PC board should be facing out when done.
22. Solder the two ends of the coax to the PC board tracks.
23. Place some flexible caulking compound on the coax, just below the PCB
24. Using the four Nylon nuts, re-install the PC board on the four Nylon screws/spacers. As you do this, the coax goes back out the hole in the enclosure and should drag some caulking compound with it, making a waterproof seal.
25. Consider polarisation. The orientation of the enclosure defines the polarisation. Keep in mind that with the enclosure VERTICAL, the antenna has a HORIZONTALLY polarized signal. The pictures show an antenna that is suitable for either a vertical mounting pole with a horizontally polarised signal, or a horizontal mounting pole with a vertically polarised signal.
26. Using the M4 screws, and the spring washers, assemble everything together. The screws pass as follows:
    – through the BACK of the ant-cap
    – through a spring washer
    – through the bottom of the enclosure
    – into the top of the enclosure

SC



Same-size artwork for the PC board "Biquad" antenna.

Terminology

802.11b A wireless ethernet standard using a 2.4GHz carrier, and supporting 11Mbps

802.11g An emerging wireless ethernet standard; 2.4GHz carrier, and 54Mbps

Channel 802.11b channels are in fact spread-spectrum frequency ranges; each 24 MHz wide, defined by their center frequency. The main channels in use are Ch1 = 2412MHz (2400 to 2424), Ch 6 = 2437 (2425 to 2449), and Ch11 = 2462 (2450 to 2474)

dBi 0dBi is reference gain seen with an Isotropic (all directions) antenna. Every 3dB increase (approx.) represents a doubling of intensity.

dBm 0 dBm equals 1 milliwatt. Every 3dB increase (approx.) represents a doubling of power.

EIRP Effective Isotropic Radiated Power. For unlicensed WiFi use in Australia, your EIRP must remain below 4W (= 36dBm). If you have a standard 30mW (15 dBm) WiFi transmitter, then the maximum antenna gain you are allowed is 36-15 = 21dBi.

Gain Antenna gain is measured in dBi. As antennas have no active components (eg amplifiers), they get their gain by focusing the signal into narrow beams. Much like a lighthouse appears to have a brighter light than it really has.

Polarisation Imagine you could see a 2.4 GHz transmitter and it looked like a light beam. If it went side-to-side, the beam is Horizontally polarized; up-and-down, Vertically polarized, and round in a circle, Circularly polarized.

WiFi 'Wireless Fidelity'. A catch-all name for standards-based wireless ethernet

Where do you get one?

The parts are available from the places shown in the article. Alternatively, you can purchase individual components, or fully assembled antennas, from Rob Clark. See **www.erlang-software.com/FreeNet/ForSale**

What's New @ Jaycar

AUGUST 03 ISSUE

OVER 5,500 PRODUCTS IN STORE JAYCAR ELECTRONICS

B&W Video Door Phone with Digital Memory Function

NEW

Not only is this a video door phone, it will take a photo when someone presses the call button and store it for later viewing. You can even check to see who pressed your doorbell while you were away. The external CMOS camera is housed in a secure metal-alloy housing with Infra Red illumination. Features include a Silent Monitor feature that allows you to view the entrance area and much more. Supplied with a 10m interconnecting cable, and a plug pack power supply.

Cat. QC-3610 $499

Switchmode 12V to 24V Input DC-DC Converter

Accepts 12-24VDC input, suitable for use with cars and trucks. Output is selectable between 1.5, 3.5, 4.5, 5, 6, 9, and 12VDC regulated at up to 1A. Supplied with 6 right angled DC plugs for compatibility with many devices. See 2003 Cat Pg 161 for details.

NEW

Cat. MP-3014 $24.95

Come and see our NEW Silverwater showroom, it's over three times the size. 100 Silverwater Rd. Silverwater. NSW.

1000V - 7 Piece Screwdriver Set

NEW

A quality set of 7 screwdrivers with storage box that offers reliability and value without compromise. GS and DVE tested and approved to 1000V. With red rubber grip handles and insulation right to the tip, you will find them amongst your tools quickly and easily. DIN EN 60900.

Driver sizes:

Flat:	Phillips:
1.2 x 6.5 x 150mm	#2 x 100mm
1 x 5.5 x 125mm	#1 x 80mm
0.8 x 4 x 100mm	#0 x 60mm
0.6 x 3.5 x 75mm	

Great for electricians & tradesman

Cat. TD-2022 $19.95

Remote Control Panning Camera Base and Controller

NEW

Features adjustable rotational range from 22° to 350° and is mounted on a strong steel wall bracket. The system comes with a control unit to manage the panning motor. The panning action can be manually controlled or set to auto pan. Supplied complete with a infrared remote-control it is very simple to install. Just wire in the camera of your choice, plug the system in, and turn it on. Max camera weight 0.5kg.

Cat. QC-3208 $179

IMAC Type Blue Powerboards

NEW

Made from a transparent blue plastic, it will match your modern equipment or give a great new look to your boring power cabling. They have built in overload protection with reset switch.

4 Way

Cat. MS-4041 $5.95

6 Way

Cat. MS-4046 $8.25

60W SMD Soldering Iron

Using a conventional soldering iron for surface mount components can be slow and clumsy. With tips available from 2 – 20mm, its tweezer design makes light work of small resistors to large 'flat pack' IC's. It heats up in just minutes, and features rapid heat recovery. Supplied with a metal stand and 2 x 2mm tips.

Cat. TS-1720 $99.95 NEW

Spare Tips Available:

2mm	Cat. TS-1701 $19.95 Pkt 2	5mm	Cat. TS-1702 $24.95 Pkt 2
10mm	Cat. TS-1703 $24.95 Pkt 2	20mm	Cat. TS-1704 $24.95 Pkt 2

Low Cost Auto Ranging DMM

This full featured meter has a fantastic 'Peak Hold' function, allowing you to see the highest reading recorded during measurement. A great feature normally reserved for DMM's costing much more. Temp. probe not included.

- Peak Hold
- Data Hold
- Transistor Test
- Temperature
- 3.5 Digit
- Diode Test
- Continuity Buzzer

NEW

Great Value

Cat. QM-1534 $29.95

B&W CCD Outdoor Camera In Metal Case With Panning Base, 2 Way Sound, Remote Control and IR Illumination

NEW

Housed in a weatherproof metal case with a built-in microphone and speaker so you can greet visitors or give instructions to callers. The camera features 6 LED IR illumination. The system comes with a control unit to manage the panning motor and enable voice communications with the area under surveillance and features a strong steel wall bracket. Supplied complete with infrared remote control.

Cat. QC-3216 $299

OVER 5,500 PRODUCTS IN STORE JAYCAR ELECTRONICS

Freecall For Orders 1800 022 888

www.jaycar.com.au

Jaycar ELECTRONICS

Miniature Radio Controlled Cars with Turbo or Sound Effects

These tiny radio controlled cars are great. They all have a 5 minute run-time, and charge in just 45 seconds. 5 different models are available, modelled on the Nissan Skyline, Toyota Supra, Mazda RX-7, Mitsubishi EVO-7, and Mitsubishi Eclipse. All models are available with either racing effects, or a turbo feature, and the cars are just 65mm long.

Nissan Skyline with Turbo Feature Cat. GT-3030
Nissan Skyline with Sound Effects Cat. GT-3035

Toyota Supra with Turbo Feature Cat. GT-3031
Toyota Supra with Sound Effects Cat. GT-3036

Mitsubishi EVO-7 with Turbo Feature Cat. GT-3032
Mitsubishi EVO-7 with Sound Effects Cat. GT-3037

Mazda RX-7 with Turbo Feature Cat. GT-3033
Mazda RX-7 with Sound Effects Cat. GT-3038

Mitsubishi Eclipse with Turbo Feature Cat. GT-3034
Mitsubishi Eclipse with Sound Effects Cat. GT-3039

NEW

5 different models each available in 2 styles

Price per Car $29.95

Too Hot To Print

Our Memory Card prices are too hot to put on paper. Drop into any store or see our website for the latest prices.

High Quality Stainless Steel Hand Tools

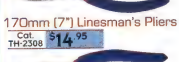
NEW

At last! A range of quality hand tools in #316 Marine Grade (3CR13) Stainless Steel.
How many times have your pliers seized up with rust? If you need to use tools in a hostile environment like saltwater, chemicals etc., then these tools are for you.

- Marine Mechanical Service
- Swimming Pool Maintenance
- Outdoor Road Maintenance
- Hydraulic Maintenance
- Marine Electrical Service
- Hazardous Wet Area/Chemical Maintenance
- Professional and Recreational Fishing

150mm (6") Diagonal Cutters

Cat. TH-2304 $12.95

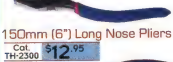


200mm (8") Adjustable Wrench

Cat. TH-2312 $17.95

170mm (7") Linesman's Pliers

Cat. TH-2308 $14.95



250mm (10") Slip Joint Pliers

Cat. TH-2322 $22.95

150mm (6") Long Nose Pliers

Cat. TH-2300 $12.95

300mm (12") Slip Joint Pliers

Cat. TH-2324 $29.95

250mm (10") Adjustable Wrench

Cat. TH-2314 $22.95

300mm (12") Adjustable Wrench

Cat. TH-2316 $29.95

Mini Radio Controlled Battle Tanks

Engage your opponent in a one-on-one tank battle with these fantastic miniature radio controlled tanks. Featuring a rotating turret with an infrared 'cannon' that can fire on an opposing tank. Once a tank is 'shot', it will remain disabled for a few seconds until it is back in action.
Two tanks are required for battle games.

40Mhz Tank Cat. GT-3042
27Mhz Tank Cat. GT-3040

NEW

Price per Tank $44.95

USB 2.0 Ethernet Network Adaptor

NEW

A great alternative to PCI or PCMCIA network adaptors. Ideal for notebook computers or any computer on the go.

- USB 1.0, 1.1 & 2.0 compliant
- IEEE 802.3u 10/100 Base-T, TX & T4 compatible
- Software / Drivers Included
- Size: 50 x 67 x 26
- Windows 98SE, ME, 2000 or XP compatible.

Suits Windows 98SE/ME 2000/XP

Cat. YN-8065 $79.95

104 Key Windows Keyboard

NEW

Features slimline design, durable soft touch keys, and energy saver control buttons. 1.2m cable with PS/2 connection.

- Beige in colour
- Measures 455(L) x 160(W) x 27(H)mm.

Cat. XC-9156 $19.95

USB Mini Optical Mouse

NEW

This mini optical mouse measures only 82(L) x 35(W) x 32(H)mm and easily connects to your PC via the USB port. It includes a wheel for easy scrolling and internet surfing. With optical technology it eliminates "dirty ball" problems and will work on almost any surface including your laptop wrist rest.

Cat. XM-5127 $34.95

USB 2.0 4 Pin (A) Male to 5 Pin Mini (B) Male

NEW

Use this lead to connect your PC to a Digital camera or other portable device. Conforms to USB 2.0 standard and is 1.8m long.

Cat. WC-7710 $9.95

Jaycar ELECTRONICS

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www.jaycar.com.au

New Range of Quality Car Alarms

Economy Car Alarm

NEW

Even though we've dubbed this alarm as an economy model, it is still feature-packed & will provide thorough protection to any vehicle.

Features include:
- Remote control arm / disarm
- Anti-interference, anti-false alarm system
- Anti-burglary and anti-hijacking

What you get:
- Electronic black-box controller
- 2 transmitter key-fob learning remote controls
- Shock sensor • Fused outputs
- Mini size siren • Ignition cut-out relay
- Wiring looms • Foot brake trigger

Cat. LA-9000 **$119.00**

Extra Remote Control

Cat. LA-9002 **$29.95**

Full Feature Car Alarm

This is our 'full house' alarm. This model includes all necessary wiring and accessories to successfully install the alarm. Alarm activated central locking and auto approach disarm functions are included for keyless entry (requires power locking kit).

Features:
- Auto approach disarm / unlock of central locking
- Anti-interference, anti-false alarm system
- Anti-burglary and anti-hijacking

What you get
- Electronic black-box controller
- 2 transmitter key-fob learning remote controls
- Shock sensor • Fused outputs
- Battery Backup Siren • Ignition cut-out relay
- Wiring looms • Foot brake trigger

Cat. LA-9005 **$199**

DUE LATE AUGUST

Extra Remote

Cat. LA-9007 **$34.95**

Two Way Car Alarm with Remote Radio Pager

NEW

This unit has a paging remote control with an alarm status LCD on the keyfob. The pager function enables the alarm to communicate with the key fob at distances between 500m - 3.3km. If someone breaks into your vehicle, the key fob will tell you which part of the vehicle has been breached! If your vehicle is suitably wired, you can command the alarm to sound the siren, flash the lights and kill the engine.

Features:
- FSK technique, high stability and anti-jamming
- Sound, vibrating and visual indication of alarm status & function
- Anti-burglary and anti-hijacking

What you get
- Electronic black-box controller
- 2 transceiver key-fob learning remote controls
- Shock sensor • Fused outputs • Battery Backup Siren
- Ignition cut-out relay • Wiring looms • Foot brake trigger
- Car transmitter • Dash-mount BLUE LED warning lights
- Battery backup siren

Cat. LA-9010 **$349**

DUE LATE AUGUST

Extra Remote Control

Cat. LA-9012 **$99**

Personal Breath Analysers

NEW

Unlike many personal alcohol detectors available, these pocket sized instruments are both accurate and easy to use. They offer a clear indication of blood alcohol, and the two units have different levels of accuracy. These units will also respond to high levels of Carbon Dioxide and Liquid Petroleum Gas (LPG).

Breath Analyser with 3 LED Indication

Gives a GO/NO GO indication of your blood alcohol. An LED illuminates at over 0.05% blood alcohol.

Cat. QM-7290 **$29.95**

Breath Analyser with 5 LED Indication

Will display 0%, 0.01-0.02%, 0.03-0.04% 0.05-0.1% and above 0.1% alcohol content.

Cat. QM-7292 **$59.95**

While offering a good indication of blood alcohol levels, these units should not be relied upon to produce precise results. Nothing should take place of responsible alcohol consumption, and you should never drink and drive.

Talking Photo Album

NEW

A photo album that talks!
You can record up to 10 seconds of your loved ones voice on each page for a lifetime of memories. A small push switch on each page plays the recording. The perfect gift!
- Holds up to 24 standard 4" x 6" photos.
- Black vinyl look with gold coloured corner protectors
- Measures 197(L) x 140(H) x 30mm(W)
- 2 x AAA batteries supplied

Cat. XC-0288 **$59.95**

USB Key GSM SIM Card Reader

NEW

Super small size, it allows you to read, write and edit all information stored on your SIM card using your PC. Edit phone book details, print and compose SMS messages. Just insert the SIM card and plug it into your USB port. Drivers and software are supplied for Win98, 2000, ME.

Cat. XC-5102 **$49.95**

Handheld Digital Compass with Stopwatch and Thermometer

NEW

This great handheld unit features an electronic compass, precision stopwatch with lap/split memory, an alarm clock, and a thermometer! It is all in a compact hand held unit, with easy function buttons, and clear display.

Cat. QM-7282 **$49.95**

ADSL Line Splitter / Filter

NEW

This ADSL splitter/filter provides an RJ-12 socket for connection to your telephone line and two RJ-12 outlets. The line outlets are filtered, removing any interference from the high speed connection. One line is for your telephone, fax, modem etc. The other socket is for the ADSL Modem/Router.
- This device meets the AS/ACIF S002:2001 specification (including the latest amendment).

Cat. YT-6094 **$28.95**

DUE LATE AUGUST - IF YOU SEE THIS SYMBOL PLEASE CALL US TO CHECK STOCK AVAILABILITY BEFORE DRIVING ACROSS TOWN.

2.4GHz B&W CMOS Wireless Camera and Monitor Set

NEW

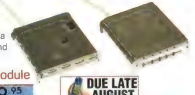
A B&W CMOS wireless camera and a B&W 5.5" monitor with no connection wires needed. Generally open air distance transmission is up to 100m. Great around the home - keeping an eye on the kids in the pool, or a sleeping baby. Can be used in retail stores, with a no-fuss installation. The camera also features infra red LED's built in for night monitoring. See our Website for details.

Cat. QC-3254 **$329**

2.4GHz Wireless A/V Transmitter and Receiver Modules

NEW

Add wireless AV technology to your appliances! These modules are identical to the transmitter/receiver modules used in our ever popular AR-1815 Wireless AV Sender. They are the bare modules, supplied in a metal case. Data sheets and pin-outs are supplied. Transmitter and receiver modules sold separately.



Transmitter Module Cat. QC-3590 **$34.95**

Receiver Module Cat. QC-3592 **$49.95**

DUE LATE AUGUST

4 Channel Digital Video Recorder with Audio and 120GB Hard Disk Drive

NEW

This full featured Digital Video Recorder will accept up to 4 video inputs, and offers a 4 way quad or switching display. It features a huge 120GB hard disk drive, which is installed in the removable case. Recording time is up to a massive 2025 hours (at 1fps, highest compression). It supports NTSC and PAL video formats, frame rate of up to 50fps, and features 4 audio inputs (1 per camera). It offers timer recording, allowing you to set up to 8 different time/date record sessions, motion detection, event recording, and much more. This is a fantastic unit, packed with features, and all at a great price. See our website for full details and specs.

- Switching or Quad Display
- 704(H) x 564(V) PAL Full Screen Resolution
- 4 Channel Audio and Video Inputs
- Video Loss Detection
- Contrast, Brightness and Colour Adjustment

Cat. QV-3067 **$1,499**

6 LED Night Light with PIR Activation

NEW

Great for security, or to help a child afraid of the dark. Activated by a PIR motion sensor, it illuminates when movement is detected, and stay on for 1 minute after it has stopped. It can also be set for constant illumination, and includes mounting bracket and screws. Requires 4 x AA batteries or 6V 300mA plugpack (not supplied).

Cat. LA-5160 **$24.95**

6 LED PIR Alarm/Night Light

NEW

Similar to LA-5160 above, though this unit can also sound a beep, and flash the LED's on and off when motion is detected. It also has a Light Dependent Resi so the unit is inactive when adequate lighting. Includes r bracket and screws. Requires 4 x AA batteries (not supplied).

Cat. LA-5162 **$24.95**

High Quality Dummy Camera in Metal Case with Bracket

NEW

Give the realistic look this high quality dummy camera. With a strong mounting bracket and weather proof housing it's a heavy duty unit made to last. For added realism it has a red flashing LED (requires 2 x AA batteries not supplied). Measures: 225(L) x 80(D)mm (excluding bracket).

Cat. LA-5313 **$69.95**

Single Channel DVR with Stereo Sound & Hard Disk Drive

NEW

This full featured Digital Video Recorder offers simple front panel controls, NTSC or PAL operation, and RS-232 remote control. It is supplied with rack mounting brackets, and a 120GB hard disk drive. It can store over 2000 hours of video (at 1fps) on the supplied drive.

Also available without hard disk drive. Cat. QV-3065, $899. See 2003 cat. for details.

Cat. QV-3066 **$1,099**

DIGITAL VIDEO RECORDER BARGAINS

Digital Video Recorder with 4 Channel Real-Time Display

The QC-3052 uses it's own 20GB Hard Disk Drive and in-built software. Although it doesn't require a PC, an RS-232 port is provided for transferring images to a PC for further review, printing, transmitting and editing. NTSC and PAL video outputs are provided to locally monitor video signals. We have made available on our website, the entire list of functions available to the QV-3052. Limited quantity.

2002 Cat Price $3,495

Almost 1/2 Price

Cat. QV-3052 **$1,795**

4 Channel Digital Surveillance Video Recorder DVR

This Professional quality recorder features a 40GB removable hard drive, external triggering, NTSC or PAL capability and password protected settings. The removable hard drive is compatible with our Cat. XC-4670 removable carrier, so the drive can be installed into a PC for further viewing and editing with the software provided.

- Switching or four-way split display.
- 352 x 288 Resolution.
- Compatible with any IDE Hard Disk up to 200GB.
- Dimensions: 420(W) x 87.9(H) x 318(D). See cat page 205 for details.

Limited quantity.

Was $1,995

Save $500

Cat. QV-3060 **$1,495**

Twin Photobeam Detector Transmitter/Receiver

NEW

This unit has an extremely large range of up to 30m. It is ideal for large entryways, driveways, or any large area which requires monitoring. It has N/O and N/C alarm outputs, with adjustable time delay. Requires 10-30VDC.

Cat. LA-5198 $199.00

Rotating Metal Dummy Camera

NEW

The most realistic dummy camera we have seen. In fact, it's almost identical to the real rotating camera that we do sell! It even has the IR LEDs and adjustable rotational range. Mains plugpack supplied.

Cat. LA-5319 $89.95

Alarm / Door Chime with Built-In PIR

NEW

You can use this compact unit to sound an alarm or to provide an entry chime if movement is detected in that area. Requires a 9V battery or plugpack. Small in size and includes adjustable mounting bracket and screws.

Cat. LA-5170 $29.95

Proton Quad Pulse Count PIR

The Proton Quad PIR is designed in the UK using advanced design and surface mount technology, it provides a very high degree of reliability and superior performance. If you require increased detection performance for high security applications then this is the ideal PIR.

Cat. LA-5025 $59.95

NEW

Micron Pulse Count PIR with N/O Contacts

NEW

Using surface mount components and a proven design, features include dual sensors, temperature compensation and a high level of immunity to RF interference. It has Normally Open contacts, ideal for triggering DVR's, multiplexers etc.

•12m 90° Coverage Pattern

Cat. LA-5035 $39.95

Digital Voice Recorder with Digital Camera

With the incorporation of a camera, you can capture good quality images to compliment your recordings. The camera has a resolution of 300k pixels (640 x 480), and can store up to 256 images. Upload to PC via the USB cable, and manipulated with the software (both supplied). See cat pg 353 for details and specs.

WAS $399

NEW

SAVE $150

Ideal for Real estate agents, insurance assessors etc

Cat. XC-0284 $249

Automatic Light Sensitive Bayonet Lamp Controller

A great alternative to PIR based 'sensor lights'. This lamp holder plugs into a standard 240V bayonet base, and accepts up to a 60W bayonet lamp. It has an LDR which will automatically turn the lamp on when it gets dark, and off when it gets light again.

NEW

Cat. PS-4074 $19.95

Digital Camera Pen

NEW

Not quite the secret agent camera, the give away is when you take a picture, the camera magically announces the shot number. Features include memory for up to 38 images, auto power off, power LED indicator and of course a twist action pen! Pictures are downloaded via the supplied RS-232 cable and viewed using the supplied software. Supplied in an attractive gift box. Compatible with Win95 or later.

BUILT IN CMOS CAMERA

Cat. QC-3380 $119.95

Camera in a Wrist Watch

Unbelievable as it seems, this wrist watch actually has a built in CMOS camera! It features memory for 40 images, a synthesized voice to announce the functions and number of shots taken. Watch features include stop watch, alarm, mini spot light and it even tells the time. Images are downloaded via the supplied RS-232 cable and viewed using the supplied software on CD-ROM. Compatible with Win95 or later.

NEW

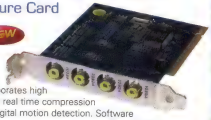
Cat. QC-3382 $119.95

BUILT IN CMOS CAMERA

Both of these items are compatible with Win 95 or later

4 Channel Surveillance Video Capture Card

NEW



Incorporates high speed real time compression and digital motion detection. Software features adjustable preview size, user defined sensitive areas and oldest date recycling. In addition, the surveillance images can be accessed remotely via a LAN, WAN or even the Internet. On average, 24 hours of video requires roughly 2Gb of hard disk. •Digital Video Recording •Digital Motion Detection •Variable Capture Rate •Simultaneous Record & Playback •Quad Display Mode •4 Camera Inputs •Single PCI Card Slot •3.0-5.0 F/S Frame Rate •1-16fpm (Modem Communication) •Supports Win2000/ Win XP

Cat. QV-3056 $399.95

DUE LATE AUGUST

IF YOU SEE THIS SYMBOL PLEASE CALL US TO CHECK STOCK AVAILABILITY BEFORE DRIVING ACROSS TOWN....

OVER 6,500 PRODUCTS IN-STORE JAYCAR ELECTRONICS

Fortis 4.7GB DVD-R

General video or data use for Mac/PC. 120 minutes / 4.7GB

1 Speed

Cat. XC-4730 $4.95

4 Speed

Cat. XC-4731 $7.95

NEW

Digital Video (DVI) Cables

NEW

Used on many Video Projectors and some LCD monitors. Two metres long.

25 Pin DVI Male to 25 Pin DVI Male

Cat. WC-7590 $29.95

25 Pin DVI Male to 15pin HD VGA Male

Cat. WC-7594 $24.95

4 Hr Digital Voice Recorder

NEW

This digital voice recorder will store up to 4 hours of voice quality audio in a neat, slim, hand-held unit. 4 separate message groups are available and each group can have up to 99 messages. The recorder has a VOX function and variable microphone sensitivity for voice operated recording. Includes PC software for editing sound files.

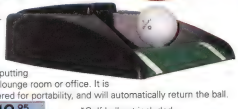
DUE LATE AUGUST

Cat. XC-0286 $169.00

Golf Putting Practice Cup

NEW

Perfect your putt at home. This great machine helps you to practise and perfect your putting skills in your lounge room or office. It is battery powered for portability, and will automatically return the ball.



Cat. GH-1020 $19.95

*Golf ball not included.

Electroluminescent (EL) Novelty Badges

- Great Halloween novelty
- Multi zone lighting effects
- Really scary theme

Scream Mask Badge

Cat. GG-2110

Fish Badge

NEW

Cat. GG-2112

Cemetery Badge

Cat. GG-2114

Happy Halloween Badge

Cat. GG-2116

Cat. ALL $14.95

80mm Fan Guard with LED Illumination

NEW

This illuminated fan guard has built in lights that slowly fade through green, red, blue and purple, adding a truly unique visual effect to your computer case, or other hardware. Requires 5VDC.

Cat. XC-5033 $12.95

Portable Active Plug-In Speaker

This compact and versatile speaker is great for Laptops, Walkman, Discman, MP3 players, etc. It plugs into any 3.5mm audio socket to give you amplified stereo sound. Uses 2 x 'N' Size batteries not included - use SB-2346 - pk.2

NEW

Cat. XC-5158 $19.95

DUE LATE AUGUST

Coffee Table Learning IR Remote Control

NEW

Stylish and sleek, this remote will look at home on your coffee table and will control your entire audio and visual system with ease. With five device zones, two of which hold dual selectable devices, gives you a total of seven devices you can control. It incorporates a range of keys that exceed the requirement of any ordinary AV system and you can even control your home air conditioning! See Cat Pg 301 for details.

- Dimensions 320(w) x 48(h) x 185(d)mm.

Cat. AR-1716 $179.00

Electric Shoe Polisher Kit

NEW

This kit consists of a battery operated motor with two sets of brush and buffer, and even includes polish! All components store neatly together in the wall mountable rack. Requires 2 x C size batteries (not supplied).

Cat. GH-1056 $19.95

Internal 6 in 1 USB Card Reader

NEW

This unit supports compact flash cards, IBM micro drive, smart media, memory stick, secure digital, and multimedia cards and it installs right into your PC so you don't have extra devices and cables all over your workspace. Suitable for PC or Mac and features true plug and play operation.

Cat. XC-4855 $69.95

IR Remote Control Jammer

Strike back at the annoying family member who dominates the living room remote control.

- Jams TV, Hi-Fi and Video infra-red remote control signals and stops them from working.
- Batteries included

NEW

Cat. GH-1084 $9.95 *Remote control not included

Anti-Fogging Shaving Mirror with Clock

NEW

This anti-fog mirror doesn't get steamed up and has a digital clock to keep track of the time. It has in-built LEDs for extra light and is supplied with suction cup, screen hook and hanger cord. Requires 3 x AA batteries (not supplied).

Cat. GH-1058 $34.95

NEW LOW COST RANGE OF NETWORK CABLE TESTERS

Multi-Network Cable Tester

The multi network cable tester is designed to quickly test UTP/STP/Coaxial /Modular network cables by auto scanning the wires for continuity, bad wiring and polarisation.

Cat. XC-5075 $69.95

Multi-Network Cable Tester with Pin-Out Indicator

This multi network cable will sequence each connection and indicate the connections via two 9-way LED bar graphs. Cables can be checked before or after installation by using the Remote Terminator (included).

Cat. XC-5076 $99.95

Cable Tester for RJ-12, RJ-45 and USB(A-B)

Plug the terminator into one end of the cable and the hand held tester into the other. 13 LED's will indicate any open or short-circuits, or cross wiring in your cables. Please note that the USB function is designed to test USB(A) to USB(B) cables.

Cat. XC-5077 $119.00

Multimeter Carry Case

Hard wearing with foam lining to cushion the meter, it zips up tight guarding it from dirty dusty conditions.
Size: 190(L) x 125(W) x 45(D).

Cat. HB-6361 $6.95

Foxtel Approved RG6 75 Ohm Coaxial Cable

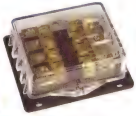
Features a solid 18AWG copper clad steel centre conductor, gas injected foam dielectric and four separate shielding layers to eliminate any outside interference. Aus-star / Foxtel approval number: F-101 70

Per Metre
Cat. WB-2006 $1.50/m

30m Roll
Cat. WB-2014 $39.95

Gold Plated Fused Distribution Block with LED Indication

Features LED power indication and gold plated terminals. It has 1 x 2 gauge and 2 x 4 gauge inputs and 4 x 4 gauge out.



Cat. SZ-2074 $44.95

18W Soldering Iron

This iron is perfect for precise soldering of delicate components. It offers rapid heat up, instant recovery, a stainless steel barrel and long life interchangeable tip. Fully SAA approved.

DUE LATE AUGUST

Cat. TS-1551 $34.95

Heavy Duty F59 Connectors

As used by TV and Cable installers. Heavy gauge with a passivated finish.

For RG59 Cable
Cat. PP-0702 $1.10

For RG6 Cable Foxtel Approved
Cat. PP-0704 $1.10

Mini Digital Weather Station and Compass

A great portable unit, featuring a backlit LCD display, barometer, compass, weather forecasting, weather history, and many clock functions. It also has a stopwatch, and includes a 3 metre temperature probe.

Cat. XC-0298 $79.95

DUE LATE AUGUST

5VDC Ball Bearing Fans with Tacho Output

The third wire provides a pulse output - 1 pulse per revolution.
See our website for details.

60mm
Cat. XC-5010 $16.95

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Backlit Temperature DMM

- Professional Look
- Data Hold • Continuity Buzzer
- Transistor/Diode Test
- Temperature • Backlight
- 3.5 Digit • Overload Protected
- Holster Included

See 2003 Cat Pg 233 for Details.

Cat. QM-1526 $29.95

Mini Non-Contact Digital Thermometer with Laser Sighting

A great way to measure the surface temperature of an object without the need to make contact with it. It features a large LCD display, data hold, auto power off, and a range between -20°C to 270°C (-4°F to 518°F), with a 1° resolution.
See Cat Pg 241 for details.

Cat. QM-7224 $99.95

DUE LATE AUGUST IF YOU SEE THIS SYMBOL PLEASE CALL US TO CHECK STOCK AVAILABILITY BEFORE DRIVING ACROSS TOWN.

Digital Instrument Display Kit For Cars

Ref: Silicon Chip August 2003

Do you prefer digital readouts to analogue meters? Our previous PIC based digital instrument kits are extremely popular. Taking the concept one step further is this 'universal' design, for use with many common automotive sensors and loads of other applications. Convert analogue fuel, oil pressure, temperature gauges, and many more devices into digital displayed units. Kit supplied with PCB, case, silk screened pre-punched front panel & all specified electronic components.

NEW KIT

Cat. KC-5365 $59.95

Auto Power-Up Kit

Ref: Silicon Chip July 2003

If you own a home theatre system, workshop, personal computer or any group of appliances which work together, then you need one of these. The powerup unit will automatically switch on your peripheral devices and associated equipment, as soon as you switch on the 'master' device. Kit supplied with PCB, silk-screened front panel, and all electronic components.

NEW KIT

Cat. KC-5363 $79.95

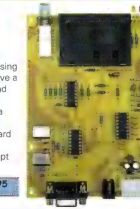
Full Function Smart Card Reader/Programmer Kit

NEW KIT

Ref: Silicon Chip July 2003

In January 2003, we released the Phoenix Type Smart Card Reader/ Reprogrammer Kit. It provide a great tool for accessing the EEPROM data of many popular Gold cards. Now we have a new design, which will program many blank Gold, Silver, and Emerald wafer cards (with relevant loader software) which conform to ISO-7816 pinout standards. PC connection is via serial port, and the PCB can powered from a plugpack, 9V battery or your ATX power supply. Kit supplied with PCB, card socket, and all specified electronic components.

•Jaycar Electronics and Silicon Chip Magazine will not accept responsibility for the operation of this device, its related software, or its potential to be used for unlawful purposes



Cat. KC-5361 $49.95

'Smart' Slave Flash Trigger Kit for Cameras

Ref: Silicon Chip July 2003

The internal flash on a many digital and film cameras works well for 'happy snaps', but can present issues when shooting portraits, or any subject requiring even lighting. This unit will trigger a separate flash system, and even works with multiple flash - red eye reduction systems used in many modern cameras. Kit supplied with PCB, silk-screened front panel, and all specified electronic components. Flash trigger lead not supplied.

NEW KIT

Cat. KC-5364 $29.95

LOOKING FOR AN OLD KIT?

If you are, we may have it in our Kit Back Catalogue. The 'Kit Back Catalogue' range is listed on the Jaycar website (under Kits & Projects) and can only be purchased via the website "www.jaycar.com.au" or Techstore (i.e. not the Jaycar stores).

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SENSATIONAL REVISED VERSION OF THE ETI-480

SC-480 50W Amplifier Module Kit Version 1

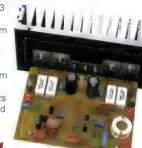
Ref: Silicon Chip 01-03 and 02-03

•Improved design from the ETI-480

•Uses TO-218 power transistors

•Supplied in short form with PCB and all electronic components

•Heatsink not included Use HH-8555



Improved design and reliability

Cat. KC-5345 $49.50

SC-480 50W Amplifier Module Kit Version 2

Ref: Silicon Chip 01-03 and 02-03

•Improved design from the ETI-480

•Uses TO-3 power transistors

•Supplied in short from with PCB and all electronic components

•Heatsink not included Use HH-8550

Cat. KC-5346 $49.50

Power Supply Kit to Suit SC-480

•Supplies +/- 40V rails to the amplifier module

•Also provides +/- 15V supply rails for a preamplifier

•Supplied in short form

•Requires 56V centre tapped transformer use MM-1095

Cat. KC-5347 $29.95

28-0-28V Centre Tapped Transformer

Suits KC-5347 power supply kit

Cat. MM-1095 $39.95

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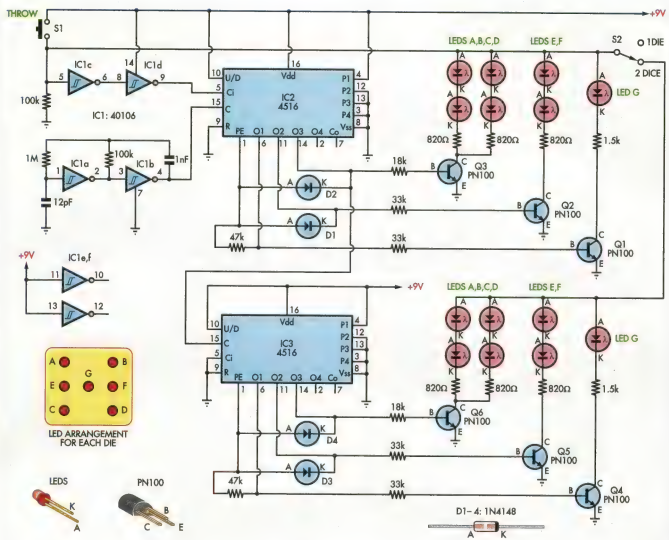
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Low-cost dual digital dice

This simple dual digital dice is based on three low-cost ICs, a few transistors and a handful of LEDs. IC1a & IC1b operate as an oscillator with a frequency of about 4kHz and this clocks IC2. The frequency of oscillation is not critical – it simply needs to be high enough to prevent cheating.

IC2 and IC3 are 4516 binary counters, configured to count in binary from 1-6. A power-on reset is not required here since, if the initial state is outside the correct range, the counters will count into the correct range after a few clock pulses.

Let's first consider how IC2 operates. When the counter reaches "7" (ie, 111), the AND gate formed by diodes D1 & D2 and the 47kΩ resistor applies a high to the PE pin (pin 1). This presets the counter to 1 (ie, 001) and so PE goes low again. The counter then increments in the normal manner until it reaches "7" again.

Counter IC3 operates in the same manner except that the clock signal is derived from IC2's O3 output.

The counter outputs (O1, O2 & O3) drive NPN transistors Q1-Q6 and these in turn drive the LEDs (ie, the LEDs indicate the states of the counters). Normally, the counters are incrementing continuously and the LEDs all appear to be lit. However, when pushbutton switch S1 is pressed, pin 6 of IC1c goes low and pin 9 of IC1d pulls the Ci input of IC2 high, thus stopping the counters.

Finally, toggle switch S2 allows the user to choose between having two dice operating simultaneously or just one.

Len Cox,
Forest Hill, Vic. ($40)

Maximum/minimum voltage indicator

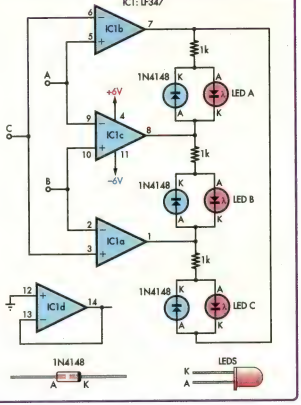
This circuit indicates which of three voltages in the range from about about -4V to about +4V – at A, B and C – is the highest by lighting one of three indicator LEDs. Alternatively, it can be wired to indicate the lowest of three voltages or to indicate both the highest and lowest voltages.

Op amps IC1a, IC1b & IC1c are wired as comparators, while the three indicator LEDs and their series 1kΩ current limiting resistors are strung across the op amp outputs to implement the appropriate logic functions. For example, LED A will light only when pin 8 of IC1c is low (ie, A > B) and pin 7 of IC1b is high (ie, A > C).

Similarly, LED B will light only when pin 8 of IC1c is high (ie, B > A) and pin 1 of IC1a is low (ie, B > C). LED C works in similar fashion if the voltage at C is the highest.

Note that if all the LEDs and their parallel 1N4148 diodes are reversed, the circuit will indicate the lowest of the three input voltages. And if each 1N4148 diode is replaced by a LED, the circuit will indicate both the highest and lowest inputs.

Andrew Partridge,
Kuranda, Qld. ($30)



Halogen lamp dimmer with soft start

Most dimmers use pulse width modulation (PWM) to control the amount of power that is delivered to the lamp. Those that come bundled with a switch faceplate control the firing angle of a Triac on the 240V mains side. These work fine with resistive loads but may not be suitable for inductive loads such as low-voltage halogen lamp transformers.

This circuit also employs PWM but it switches at a high frequency (22kHz) on the low-voltage side of the lamp transformer. This high frequency also simplifies EMI filtering. Furthermore, because this circuit is isolated from the mains by the transformer, it is relatively safe to build and install.

IC1 is a standard 555 astable oscillator with a high duty cycle. It produces a narrow negative-going pulse at its pin 3 output approximately every 45µs (ie, the frequency of oscillation is about 22kHz). These pulses trigger IC2, another 555 timer, this time wired as a variable monostable.

IC2's pin 3 output is normally low which means that its internal discharge transistor is on and the 1nF capacitor on pins 6 & 7 is discharged. However, when the monostable is triggered (by IC1), its output goes high, the internal discharge transistor turns off and the 1nF capacitor charges via VR1 & VR2 until it reaches 2/3Vcc. At this point, the output at pin 3 switches low again.

Each time pin 3 of IC2 goes high, it turns on power Mosfet transistor Q1 which in turn switches on the lamp.

Potentiometer VR2 is used to control the time it takes the 1nF capacitor to charge to the threshold voltage and thus sets the width of the output pulses. At maximum resistance, the pulse width is 55µs. This is longer that the 45µs period of oscillator IC1, and so IC2's pin 3 output is high for 100% of the time and the lamp operates with maximum brightness.

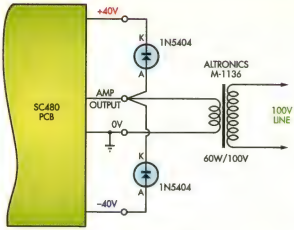
Now consider what happens if the monostable's period is shorter than the astable's. In this case, each time IC1's pin 3 output goes low, pin 7 of IC1 also goes low and discharges IC2's 1nF timing capacitor via D3. This retriggers the monostable.

As a result, IC2 is triggered at a 22kHz rate and produces variable width pulses depending on the setting of VR2. It's output in turn pulses Q1 to control the lamp brightness.

D2 isolates IC1's timing circuitry from IC2's. VR1 is used to set the minimum lamp brightness when VR2 is at minimum resistance. If this control is not required, VR1 can be replaced with a 1.8kΩ resistor.

The 220µF capacitor on pin 5 of IC2 provides a soft-start facility to prolong lamp life. Initially, when power is first applied, the 220µF capacitor is discharged and this lowers the threshold voltage (which is normally 2/3Vcc). That in turn results in shorter pulses at the output. As the 220µF capacitor charges, the threshold voltage gradually increases until the circuit operates "normally".

For the prototype, Q1 was a BUK553-60A, rated at 60V, 20A & 75W. Q1's maximum on-state resistance is 0.1Ω, so switching a 4A lamp load results in a maximum power dissipation of 1.6W. The bridge rectifier comes in at around 5W and so



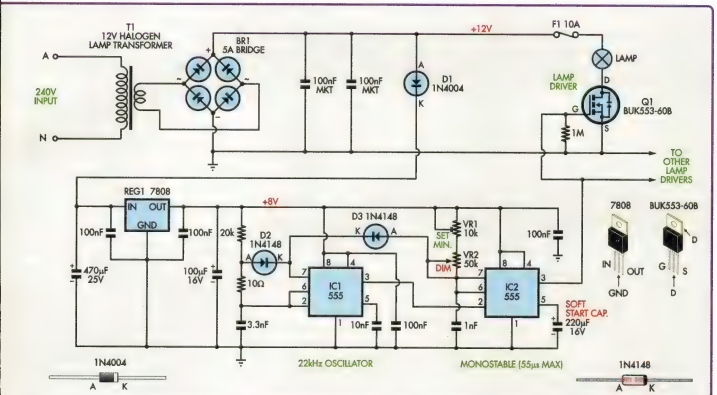
Correction – 100V line connection for SC480 amplifier

The circuit showing how to connect a 100V line transformer top the SC480 module in last month's issue was incorrect. It showed a 1N5404 diode connected from -40V to 0V. It should have connected to the amplifier output instead. The circuit is presented correctly here.

SILICON CHIP.

CONTRIBUTE AND WIN!

As you can see, we pay good money for each of the "Circuit Notebook" contributions published in SILICON CHIP. But now there's an even better reason to send in your circuit idea: starting next month, the best contribution published will win one of these superb Peak Atlas LCR Meters - valued at around $195.00. So don't keep that brilliant circuit secret any more: send it to SILICON CHIP and you could be a winner!



both should be mounted on suitable heatsinks. The power dissipation in the bridge rectifier can be reduced by using power Schottky diodes rated at 5A or more.

The output of 555 timer IC2 is capable of directly driving several Mosfets (up to four in tests). Note, that if the Mosfet is going to be some distance from the 555, it will be necessary to buffer it.

Power for the control circuitry is derived from 3-terminal regulator REG1 which produces an 8V rail. This in turn is fed from the output of the bridge rectifier via diode D1

Dennis Chuah,
Waitakere City, NZ. ($50)

SERVICEMAN'S LOG

The set without a chassis

I've got rather a mixed bag this month, including an 80cm set that came in without a chassis! There are also several fairly routine faults and finally, a set that literally came good by itself!

One evening, just as I was closing up to go home, a young man in a fairly excited state arrived and began knocking on the door. I let him in and asked him what he wanted and he replied "What do you charge to provide and replace a part for a TV?"

It was the way he phrased this that threw me. So I asked him what part, which set was it for and where did he want it putting?

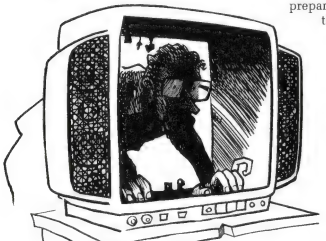
"Look", he explained, "I have a TV – in the car – it has a part missing and I want you to put it in".

I thought I had better check this out and so we went over to a small 3-door hatchback. He opened the tailgate and inside was a monster TV. Truly, I don't know how he managed to get it into such a tiny car.

The set must have been an 80cm model and was face down. The brand was Grundig but something wasn't quite right about the whole thing. I persuaded the animated young man to start at the beginning and tell me what happened.

Eventually, the story came out. The set had belonged to a company and had been sent out for repair by a service organisation. However, the quote to fix the set had been too high and the company decided to buy a new TV instead. Our young man had offered them $200 to purchase the old set and brought it to me to be fixed.

It was then I noticed what was really wrong with the set – there were large holes in the back. These are normally filled with an A-V connection panel and a closer inspection revealed that the entire chassis was missing! I didn't think my potential client was prepared to pay for me to replace that!



Somewhat humbled, the young man went back to find out where the rest of his set was – I never saw him or the set again!

Faulty Sanyo

It seems that most problems associated with Sanyo CTVs, which are generally very reliable, are caused by faulty high-value resistors, in particular 120kΩ 0.5W units. For years, these resistors have failed in the start-up circuit for the switchmode power supplies from the A1 series to the A8 – well over 10 years, in fact. Perhaps it's Australia's harsh weather conditions that make this one value fail so often?

Recently, I had a Sanyo C25PG51 (AA1-A25 chassis series) with no picture or on-screen display. It didn't take long with an oscilloscope to realise that the signal was getting as far as the CRT panel where it disappeared into a morass of transistors. All the voltages seemed correct everywhere I measured and I was beside myself with what could be wrong.

I was only saved when I spied what I thought was one of these resistors. Actually, it turned out to be a 220kΩ unit and it was marked R792 on the PC board. It measured open circuit and replacing it fixed the problem.

Later, I tried to identify it on the circuit diagram but was unable to do so with any degree of certainty. That's because all of the components are marked on the circuit with a 4-digit code after the "R' – ie, there is no R792. I can only assume that it is either R2792 or R1792, the latter a 120kΩ unit from the +210V rail to the base of each of the three push pull video output stages.

Another Sanyo

Mrs Talbot's Sanyo CPP-2140 (A3-C21 chassis series) had no colour on any channels, including the AV inputs (I always interrogate the customer on these little details as it may only be an aerial or tuning problem). Sometimes, you can be lucky and troubleshoot these in the home but, more often than not, it needs to be in the workshop with an oscilloscope and a service manual. Well, at least I had the former and a circuit for a similar chassis model.

The main difficulty, as far as I am concerned, is that there is no easy way to troubleshoot the jungle IC (IC101, LA7680) for colour faults. The colour killer circuit at pins 41 (6.2V) and 39 (5.6V) could not be overridden, either by tying them to the 9V

rail or to ground. This would have been really useful as I could then work out from the picture which area to attack.

For example, if the colour was running, I could examine the reference oscillator, burst and ident and line pulses for synchronisation.

I started by checking the DC voltages around the jungle IC to find them all pretty well spot on. I then checked the reference oscillator crystal on pin 16 with the CRO and a frequency counter – it was spot on at 4.43MHz.

By connecting a colour bar generator to the AV socket, I could see the chroma signal on pin 40 but nothing was coming out at pin 14. Obviously, the bandpass amplifiers were not being switched on, but why?

Because of the nature of large scale integration, it is not possible to have access to a lot of the circuitry inside such an IC or even guess how it works. Because of the work involved, I was extremely reluctant to change the IC but was finally about to do this when I noticed that by freezing and touching the components feeding pin 17, I could occasionally could get a flash of colour.

Pin 17 APC F (6.2V) feeds the VCO and ACC parts of the decoder. This in turn is fed by a twin resistor divider from the Vcc rail – R263 (220kΩ) and R264 (3909kΩ). The latter had gone very high in value and replacing it dropped the voltage to 5.9V and brought the colour back. However, just why lowering the voltage to an unpublished figure should fix the problem is beyond me!

The old Sony

An old Sony KV-2113GE came into the workshop with the fault description "sound low and unclear".

When I switched it on, the picture was fine but the sound was intermittently poor. Suspecting electrolytic capacitors and dry joints, I gave the power supplies and audio output stages a good going over but the fault remained, even when I applied freezer and heat.

I was about to replace the audio output IC when I decided to remove the loudspeaker, as the leads weren't long enough to enable me to work on the chassis and still have it connected. It was then that I noticed that touching the cone of the loudspeaker made a difference.

A close examination revealed that there was a bad connection between the copper braid and the voice coil that's attached to the cone. After messing around with it for a while, I ended up replacing the loudspeaker, which fixed the problem.

Bread and butter

Panasonic IC451 vertical output ICs have helped put bread on the table for me and others for many years; in particular, the dry joints on the inadequate solder pads provided on the PC boards on all models. That is, until recently – from the MX-7 chassis onwards, the soldering has been perfect, only now on the MX-8 chassis, the 1Ω 1W fusible resistors randomly blow and on the M-17 chassis, the LA7833 destroys itself, taking the feed resistor as well.

On the EURO3 chassis, the resistor is replaced by a "button" fuse which blows when the IC fails. The C150A chassis has the worst combination of faults. As the dry joints deteriorate, IC451 (LA7838) and C455 (100µF, 35V) begin to fail and the set's protection circuit starts to operate as the 12V rail becomes loaded down under the strain. This gives the effect of the set intermittently not wanting to start.

Ironically, when the set does start, the picture and sound are excellent. If, at this stage, the dry joints aren't fixed and C455 immediately replaced, the IC will fail completely.

The problem is that you spend hours trying to troubleshoot an elaborate power supply when it is a vertical timebase fault. This is compounded with an intermittent shutdown problem on earlier models due to the overcurrent protection circuit (D836) being too sensitive. R835, R848, C831 and C838 were changed in values to overcome this.

Mrs Lawson's Panasonic

Mrs Lawson brought in her Panasonic TC-36PM10A (MX-7 chassis) portable, complaining that the set wouldn't go. Fortunately for me, she mentioned that just before it finally wouldn't work anymore, the width was intermittently too wide.

When I switched it on, all I got was the LED flashing slowly – obviously the protection circuit was working. The problem with protection circuits is that they are difficult to find, understand and disable without causing major damage, and all too often are faulty themselves.

In this instance, I was extremely grateful for Mrs Lawson's final comment about the width. After measuring the main B+ rail to see it was correct and steady, I concentrated my search around the horizontal deflection circuit. Unplugging the horizontal defection yoke plug (DYH) restored the sound and I had a vertical white line down the screen.

Well, it could have been that the yoke was short circuit but it was more likely to be a fault in the east-west correction circuit. I checked D556 and D557 and was working my way to-

Items Covered This Month

- Sanyo C25PG51 TV set (AA1-A25 chassis).
- Sanyo CPP-2140 TV set (A3-C21 chassis series).
- Sony KV-2113GE TV set.
- Panasonic TC-36PM10A (MX-7 chassis) TV set.
- STA TVP-50505K 46cm TV set.
- Philips 29PT9418/79R TV set (MG3.1A chassis).

wards IC701 (TEA2031A) when I examined L701. There was a slight discolouration on the outside and it looked as though it had been under stress. My circuit showed it as an 8.2mH coil but my meter read only 0.1mH. A new one fixed the problem completely.

Ooh, la la

An interesting set came in last week. It was a French Samsung televideo all the way from La Belle France. Mrs Serviceman was completely taken in by Jean-Paul's accent and there were hormones and pheromones flying everywhere. In fact, she was so besotted by him that she barely noticed what it was she was booking in.

It, in fact, was a 1997 TVP-50505K STA 48cm set using a SCV11A chassis which was made in Spain (a multi-standard model). The fault was that it tried to start and cut out after five seconds.

I managed to hire a service manual for a similar model using the SCV11 chassis but its power supply bore no resemblance to this set. I knew that the main B+ should be +125V and I soon discovered that it came from D812k and the switchmode power supply. My meter showed this momentarily reading +170V before it closed down.

Without a close circuit diagram to refer to, I knew it was going to be difficult. I started by replacing four electros in the "hot" side of the power supply and two on the secondary to no avail. I then replaced the STRS6707 chopper IC (IC801) but this also proved futile.

I was trying to figure out how the switchmode power supply worked when I realised there was an optocoupler and the control circuit was on the secondary side. It was at this point that I was exceedingly lucky to see and recognise Q803 as an SE125 – a 125V control IC driver. These are notoriously unreliable in all brands of sets and replacing it cured the fault.

The next problem was trying to tune the set. It is fitted with two parallel digitally operated tuners on the main chassis.

I can only speculate that one was for the TV and the other for the VCR. Of course, the menus on the OSD were all in French and so was the instruction booklet. Eventually I found the menu to change the language to English and was then able to set up the tuning and controls, though I didn't discover how to tune the second tuner.

Jean-Paul was ever so delighted and Mrs Serviceman was on the verge of eloping with him when his gorgeous better half arrived and put them both in order!

Dead & urgent

Today, I had a very unsatisfactory outcome with Mrs Taylor's Philips 29PT9418/79R (MG3.1A chassis) which was brought in as dead and marked urgent.

When I checked it, the set would switch on to the Standby Red LED mode. When the remote power button was pressed, the Red LED became green, then yellow and then red before flashing.

According to the service manual, the way to fix this is to just plug in your DST (Dealer Service Tool) and it will tell you what is wrong. The trouble is that this is rather expensive to buy at around $500 – assuming that it's available. It is rather like an ordinary remote control, except that it has 2-way communication with the TV and can read and write data to and from the set.

Anyway, I had to troubleshoot this set the old-fashioned way with a multimeter.

Access to the underside of the PC boards is extremely difficult, the exception being the power supply B board on the righthand side. What I needed was good access to the line output transistor but this required removing an awful lot of plastic architecture and support frames for each of the boards. What's more, these boards

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Car Projects, Volume 2

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are interconnected via concealed locking plastic clips as well as by screws, not to mention cables in cable ties. It is very easy to break a lot of this if you cannot fathom out how they all interlock.

The first thing was to establish to what extent the power supply was working. It had to be working a little for the LED to come on at all (ie, the +5V standby). I tried to measure the nine voltage output rails but the power supply closed down too soon to allow this. I then tried overriding the protection system by unsoldering D6271 to transistor 7250 but this made no difference. However, disconnecting D6270 from the Standby rail made the power supply stay on and I was able to confirm that all rails were working OK.

The next step was to examine the deflection board (A1). After a very long time, I managed to detangle the wiring and plastic support brackets to check out the soldering. All was OK and so I checked the line output transistor (7421, BU2520-DX) with an ohmmeter – it too was OK.

Next, I checked to see if there was +141V to the collector of this transistor. This was correct so I decided to check the line drive. First, I had to reconnect protection diode D6270 as there would be no output from the oscillator. I then traced the line drive signal route from the small-signal panel surface-mounted IC via transistors 7407 & 7411 and transformer L5410 to the line output transistor.

When I switched the set on, the waveform was only there momentarily but it was good and strong until finally I connected the probe to the collector of the line output transistor. At first it was like the rest of the set, with it trying to come on but not staying on. However, the second time I switched on, the whole set suddenly came on and stayed on.

No matter what I tried to do now, the set just wouldn't go off other than by using the appropriate remote control or main switch. I bashed it, froze it, heated it – I tried everything. The !@#$% set had fixed itself!

Finally, I reassembled it and left it on test but it just refused to show the fault again.

MRS SERVICEMAN WAS SO BESOTTED BY HIM, SHE BARELY NOTICED WHAT IT WAS SHE WAS BOOKING IN

Getting this far had taken me three hours and now the set was fixed for no apparent reason. I was left to contemplate what to charge, what to say and what to guarantee. Somehow, measuring the waveform on the collector of the line output transistor had shocked a faulty component into working – but which one? I decided to replace the line output transistor and I told Mrs Taylor what had happened and why I could only apply a limited warranty. She was quite happy with that and she paid for the transistor and labour.

I was of course extremely unhappy and am now just waiting for the recall. Subsequently, we have had a lot of the later Philips 29PT6361/79R sets which employ an A10A chassis made in China. This set has a lot of intermittent faults which can be identified if you can get into the SDM (Service Dealer Mode) and then the SAM (Service Adjustment Menu) and read the error codes.

Inevitably, it turns out to be the SSP (Small Signal Panel) that needs to be replaced, as this cannot be repaired (the surface mounted chips are just too small). However, the MG3.1 hasn't yet needed this. **SC**

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The PortaPAL

Fitting a Wireless Microphone

Back in the February and March issues we described an all-new portable PA System, the PortaPAL. It was always our intention to add a wireless microphone to the system for extra versatility . . .

To say that the PortaPAL PA Amplifier has stirred up a lot of interest is something of an understatement. We've fielded a lot of enquiries here at SILICON CHIP – not the least of which was "is there a kit available."

If we might digress for a moment and answer that question, Altronics (1300 797 007) have produced "short form" kits for both the amplifier and the power supply/charger.

By short form, they mean that the PC boards and all the electronics are supplied but not the "hardware", although the heatsink and a screened front panel/chassis ***are*** included in the main amplifier kit.

The main amplifier kit (Cat K5360) sells for $179.95, while the power supply/charger kit (Cat K1695) sells for $19.95. So for less than $200 (not much less, but less!) you get the bulk of the project. Compare this with $575 for Altronics nearest "built up" equivalent and it represents very good value for money.

What don't you get? You have to supply all of the timber/woodwork, box hardware (corner protectors/top hat, handle, etc) and the speaker carpet. Importantly, the amplifier kit also does ***not*** include the speaker itself.

The power supply kit contains only the PC board and on-board components – it does not include the 12V battery or the AC plugpack.

Altronics General Manager Brian Sorensen told us that they had decided to go the "short form" route to make the kit as versatile as possible. "Many people want to make variations to the basic design," he said, "and our kits make this easy."

Yes, you're still going to have to build the box. But we showed you how to do that in the March issue.

Revisited:

PART 3: BY ROSS TESTER

OK, so that's the kit out of the way. Now let's get back to the purpose of this article: adding a wireless microphone.

But first, we might have a quick look at wireless microphones in general.

VHF vs UHF

Until fairly recently (the last couple of years or so), by far the majority of wireless microphones used in Australia were VHF models – especially for non-professional and semi-professional applications. Most transmitted in the band between about 150MHz and 210MHz, which is predominantly occupied by television stations.

By judicious choice of frequencies according to your area, you could obtain a wireless mic that didn't suffer interference from either the TV audio or video signal. (Given the dramatically higher transmission levels of the TV station compared to the wireless mic, – a hundred thousand watts or more compared to a few milliwatts – the TV station always won any battle!)

But even that cosy situation changed when the government (in their wisdom) decided to introduce VHF digital TV services in the "gaps" between analog TV services. So if you take Sydney for example, TV channels 6, 8, 11 and 12 became "no go" zones for wireless microphones.

The vast majority of those who already had wireless mics on these frequencies (and there were literally thousands upon thousands of them) simply had to replace them. There was a flurry of activity on Ebay and similar auction sites as those "in the know" unloaded what were about to become paperweights.

Some very fortunate people, especially outside the capital cities, were able to buy cheap VHF wireless mics which were, and arguably forever will be, perfectly usable in their locations because there was no VHF station, analog or digital, using that frequency in their area (most non-metro digital signals are or will be UHF).

But most people *do* live in metropolitan areas – state capitals, mainly, which by and large all have the same 2/7/9/10 VHF TV bandplan. Ergo, the same 6,8,11,12 digital bandplan.

It's true that there remains a very small window between TV channels 9 and 10 which is (thus far) unallocated and therefore remains usable for VHF wireless microphones. But this space has become somewhat crowded and it's not unusual for a sports announcer to have the local gym instructor belting out her movements on the same channel. (Trust me, I speak from experience here . . .)

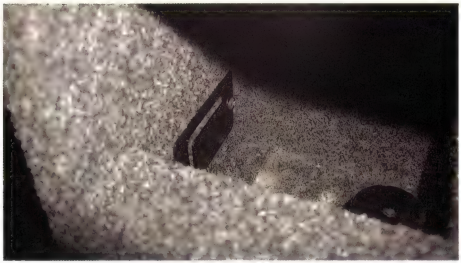
So what is the alternative?

It's quite difficult to buy a VHF wireless microphone these days. To avoid the digital TV problem, most have gone into the UHF band – up around the 800MHz mark or even higher.

The frequency collisions of VHF aside, UHF does have some significant advantages for users. First, antenna lengths are less – much less. A typical whip antenna at 200MHz is about 300mm long, although loading within

The "Redback" 16-Channel Mini Wireless Microphone System from Altronics. It operates on the UHF band, away from digital TV interference. In the receiver pack, you get the diversity receiver, 12V plugpack supply, 6.5mm to 6.5mm audio cable, "screwdriver" (for adjusting squelch level), the 2-part mounting bracket and the two screws to fix it to the receiver. The microphone is sold separately.

Here's that two-part mounting bracket which makes it so easy. One part screws to the back of the receiver while the other attaches to the surface on which it is to sit. Push one part inside the other and . . . presto!



It's just as hard to get a decent photo inside the completed PortaPAL case as it is to get enough room to install the mounting bracket! This shot looks down into the well, the bracket on the left (the black disc on the right side is the top hat).

the circuit might reduce this a bit.

At 800MHz, that has shrunk to about 90mm (or less). Second, when using a "diversity" system of reception, the two antennas do not have to be anything like as far apart as on VHF (the distance apart is a function of the wavelength).

Diversity, by the way, refers to a system of reception where two separate antennas and two separate receivers are used, with the system determining which has the best signal and automatically selecting that one. It can (and constantly does) switch back and forth as signal levels change, particularly if the radio signal source (eg, a wireless mic!) is moving around. This is done in a way which is completely transparent to the user.

There are some disadvantages of UHF. The main one is that UHF signals are more readily blocked by the body, as anyone who has used a modern wireless mic will attest. One solution is to always face the receiver/antenna – but this is not always practical. Overall range, too, is theoretically reduced on UHF – but in practice they tend to be much the same.

And all that brings us back to our selection of a wireless microphone for the PortaPAL.

Size does matter!

There is not a great deal of room left inside the PortaPAL case. And most of the wireless microphone systems around are built into 19-inch rack mount cases – not because they need to be but because that's what the professionals demand.

At first, we thought that we might have to mount the Wireless Microphone Receiver either on top of the case or on one side. Apart from spoiling the aesthetics of the PortaPAL, that would also place the receiver in a position where it (or more particularly its antennas) could be damaged (and that's easily done!).

Incidentally, you might wonder why we did not look at building our own wireless mic system. The reason is threefold: (a) wireless microphones are radio transmitters and as such have to be "type approved". It is not economic or even practical to try to obtain approval for a DIY UHF system; (b) speaking of economics, it would be difficult to build a system for what you can buy them for and (c) building anything for UHF requires rather specialised componentry, techniques and most importantly test equipment that the average hobbyist probably would not possess.

So a commercial system it had to be. Another thought that crossed our minds was to "gut" a commercial receiver and just put the "works" in-

Selecting the operating frequency is as easy as setting DIP switches on both the microphone (transmitter) and receiver. But make sure both are the same, or you won't hear a thing. Two "AA" cells power the microphone/transmitter.

side the PortaPAL. It's messy and would certainly void any warranty.

That's when we spotted a couple of much smaller receivers from our old friends, Altronics. Sold under the "Redback" brand, one was described as "half rack" size (or about 240mm wide) while another was even smaller – a tiny 130mm wide (for the record, 130 x 90 x 35mm, plus antennas).

Both were 16-channel units, the operating frequency being selected by DIP switches on both the receiver and transmitter. Both could be used in conjunction with up to five other transmitter/receivers at the same location without interfering with each other (in case you wanted to use them for multiple performers, actors, etc).

And both had either hand-held or belt-pack transmitters available. We imagine most users would prefer the hand-held mic (which we chose) but the belt-pack also has its uses – it allows the use of a headset mic, for example, freeing up the user's hands.

Given the limited space inside the PortaPAL case, we chose the smaller of the two, the Redback C8866. And in retrospect, that was a very wise decision – it fits inside the case beautifully where the larger one definitely would not have. (As for the 19-inch model, well. . .)

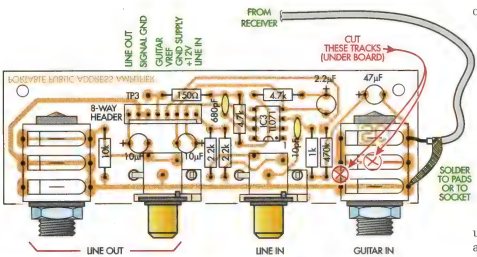
The smaller unit also had a price advantage – almost $250 less than the slightly larger model and $330 less than the rack-mounting model. Of course, the rack-mounting model is more a professional type, with increased specs and performance.

The inbuilt antennas are both an advantage and a disadvantage. They cannot be removed to allow higher gain antennas to be fitted but they're nice and small so there is less risk of damage. They can also swivel to ensure they are always vertical, regardless of whether the receiver sits horizontally or vertically.

The main disadvantage of the Mini Receiver compared to its big brothers is that the very small (70mm high) one-piece antennas do limit the range and cannot be removed. In typical (professional-type) use, if you are after longest range, you would normally use external (gain?) antennas, often mounted up high, usually with a booster. But with this receiver, you cannot do that. Given the majority of uses for the PortaPAL, we don't see that as a major problem.

The antennas can swivel through 360° horizontal and nearly 180° vertical so can handle vertical, horizontal or even angled mounting. (It's quite important to have the antennas oriented the same direction as the microphone – ie, vertical).

You can just see the receiver on the side wall of the PortaPAL – the two antennas aligned vertically as this then gives the same polarity as the (normally) vertical microphone. As yet the power cable and audio output cable haven't been installed.



Here's how to permanently connect the audio output from the wireless mic receiver into the guitar input. Connection can be made to either the tracks under the PC board or to the pins of the 6.5mm socket – it doesn't matter which. Note the tracks underneath the socket which need to be cut to stop it shorting.

On the plus side (if you'll pardon the pun), it was designed to operate from a 12V DC plugpack. We already had a perfectly good 12V supply inside the PortaPAL, so would be able to operate from that – completely portable, if we wanted to.

Output level is only stated as "line level" (that usually means somewhere between 100mV and 1V) but as there was also an inbuilt "volume" control on the receiver, we didn't see that as a problem.

We had always intended to use the "guitar" input on the PortaPAL (16mV min, 1.9V overload) as the input for our wireless mic so if there was any overload problem, it would simply be a matter of winding down the wick!

(We could have just as easily used the "line in" socket but we often use this input for a cassette or CD player – and my guitar playing is about as good as my quantum mechanics).

Of course, we could have also adjusted the feedback resistors around the guitar input opamp (IC3) to decrease the sensitivity – but didn't find that necessary. If we ever do need a guitar input, it's still there!

Output from the receiver is via a 6.5mm phone socket (a 6.5 to 6.5mm lead is included). We wouldn't need to open the receiver case at all!

Finally, the mounting of the receiver is delightfully simple. A miniature 2-part mounting bracket is supplied: one half screws to the receiver, the other half to the mounting location – and the receiver simply drops into place. Easy!

Test it out first!

Assuming your PortaPAL is already constructed (or at least the electronics is complete) it's a good idea to connect the receiver (to the guitar input socket via the 6.5mm to 6.5mm lead), plug in the plugpack and check that the system works!

You should find that both receiver and transmitter are set to channel 1 as supplied from the factory but if the DIP switches are different on each you won't hear a thing!

(By the way, the wireless mic receiver is supplied with a chart showing which channels can be used with similar wireless mics to avoid interference between them).

Still nothing? Ummm. . . have you remembered to put two "AA" cells into the microphone?

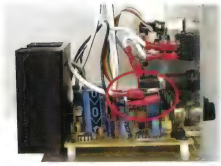
Check to see what setting of the receiver "volume" control is most appropriate (if the fault LED lights, it's clipping and is too high).

Mounting it

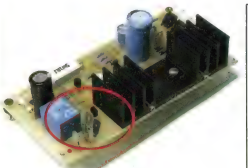
The prototype PortaPAL, as you may recall, was made with an open well at the bottom, alongside the battery compartment. The main reason for this was to store the plugpack but could also store microphone leads, etc.

It was also the perfect place for mounting the wireless mic receiver. It could mount vertically on the side wall with room for the two antennas to also be positioned vertically. Being craftwood, the PortaPAL case would not substantially block the RF signal from the microphone transmitter.

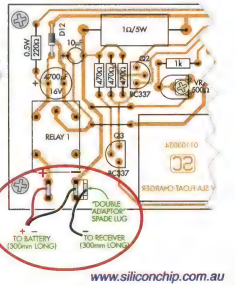
Well, maybe it was not the *perfect* place – ideally, we would have liked to mount the receiver higher to give it the best possible range. But we're



And here's where we connected one of the power leads. We found it easiest to connect the +12V to a "double adaptor" spade lug on the "fused" side of the fuse, as shown in the above photo . . .



. . . and 0V to another "double adaptor" lug on the "–" connection to the power supply PC board. Only the relevant section of the board is shown at right. Make sure you pick the correct spade lug to fit the double adaptor to!



Parts List – PortaPAL + Wireless Microphone

1 PortaPAL PA Amplifier (see SILICON CHIP, February & March 2003)
1 "Redback" UHF diversity Mini Receiver (Altronics C8866)
1 "Redback" UHF Wireless Microphone (Altronics C8872 or C8875)
1 300mm length of shielded audio lead
1 300mm length light duty polarised figure-8 cable
1 6.5mm mono phono plug
1 2.5mm DC power plug
2 "piggyback" (or double adaptor) spade lugs
2 woodscrews, 12mm long (for mounting bracket)

pretty happy with the range we achieved, along with the simplicity of receiver mounting.

Having said it was simple, mounting the receiver was probably the hardest part, because we were doing it after the case was finished – after the horse had bolted, so to speak. It would be much easier done during the case construction because you would have more room to work with.

How do you get the right spot for the bracket? You could measure carefully and hope for the best, or you could do what we did: cheat!

We used the photographer's best friend – Blue-tak. (Being a photographer helped – I had some on hand!) All you have to do is "sticky up" some Blue-tak by briskly rubbing and kneading it between your hands, then sticking this onto the back of the rear half of the bracket (the bit that is to be screwed in) with the two halves of the bracket assembled on the receiver.

Find the spot you want to mount the receiver, then press it firmly against the wall. Hopefully, the Blue-tak will stick to the surface and you can carefully slide the receiver off with the back half of the bracket exactly where you want it. It worked for us!

As there are only had two screws to install it didn't take too long (there were a couple of barked knuckles and a few undeleted expletives but we won't go into that).

Anyway, the receiver mounting plate was secured and the receiver (with the other half of the bracket already affixed) was simply dropped into place.

This placed all of the receiver's external connectors – power, output (and also the screwdriver socket to adjust the squelch level, if required) on the top of the receiver where they could be most easily got at.

The "volume" control was at the bottom of the case but could still (just) be reached and adjusted if needed. Once the right level was set, though, it could basically be forgotten.

Wire-in or plug-in?

There's a choice here. You could simply connect the 6.5mm lead to the output of the receiver, out the back of the PortaPAL and into the guitar input on the panel and you would then have a Wireless Mic system which could be removed at will. It's easy, but looks just a bit messy.

Or you could wire the receiver in permanently. We chose the latter path because we didn't intend ever separating the receiver and PortaPAL once finished. And even if we did, it wasn't too difficult to remove anyway.

Woops. . . It shorts out!

However, there is a "little" problem here: the 6.5mm socket shown on the circuit diagram (and used in the prototype) is a switching type, which effectively shorts out the input if nothing is plugged in. (The reason for this is to minimise noise from the unused input).

But that short creates a minor problem after soldering the wireless microphone output in parallel with the socket: no audio signal!

Fortunately, the solution is very simple – cut the two PC board tracks shown (underneath the guitar input socket) and the short disappears. Of course, you could fit a non-switching/shorting socket instead . . .

While we had the supplied 6.5 to 6.5mm lead and could have simply chopped it off at a suitable length, we were reticent to cut up a perfectly good cable – one that might come in handy for something else!

So we made up another short cable from a 6.5mm plug and a 300mm length of shielded audio cable and soldered it to the "input" PC board, where the guitar input socket connects.

We similarly made up a power lead using a 2.5mm DC plug and a length of figure-8 cable. Note that the centre of the socket is the positive – we don't know if there is any protection diode inside the receiver (no, we didn't even lift the lid!) so don't take a chance.

The opposite ends of the power lead connect, naturally enough, to appropriate +12V and 0V points.

The +12V wire needs to connect to a switched supply line. The easiest source for this is right after the fuse. We used a "double adaptor" spade lug directly on the fuse terminal (on the "fused" line to the PC board).

The 0V supply can go to a variety of places, again using a double adaptor space lug. We used the 0V supply connection point on the power supply PC board.

In use

There really isn't much to tell here. It works and that's that! The instruction booklet supplied with the receiver gives you several troubleshooting steps, just in case.

The range of your wireless microphone can be significantly extended by mounting the PortaPAL up high – that's why the top hat connector was included.

You should be able to easily achieve the stated 30m minimum and most of the time, it should be 50m or better.

We mentioned before that the receiving antennas should be aligned the same way as the microphone is held. The reason for this is to achieve maximum range.

It's good practice to hold the microphone nearly vertical if that's the way the antennas are set because once you depart from transmitter/receiver antenna alignment, the signal loss becomes significant.

(Besides, for both the microphone's sake and for personal hygiene it's also good practice to speak/sing across a mic rather than directly into it, as many performers are prone to do)!

Finally, wireless microphones are no different to any other microphone when it comes to acoustic feedback. Avoid getting too close to the speaker – especially at high volume levels.

Remember that the back of the unit is not sealed so feedback can occur from both front and back. SC

Jazzy Heart Electronic Jewellery

By THOMAS SCARBOROUGH

Want a flashy piece of jewellery for the love of your life? Then build the "JAZZY HEART", an eye-catching LED flasher in the shape of a heart. It could be worn as a brooch or as a pendant.

Here's a piece of jewellery that you can be sure is unique. Go to a party and you will know that nobody else will be wearing something like the Jazzy Heart.

It's a heart-shaped LED flasher using two ICs and eight different-coloured high brigtness LEDs. It is powered by a 12V miniature battery and turned on and off by a mercury switch.

The Jazzy Heart randomly flashes eight LEDs using just two common CMOS ICs. These LEDs are arranged around the perimeter of a red plastic "heart" template (or for Christmas, a green plastic "Christmas tree" template) to pulse eight water-clear LEDs.

A special feature of the design is that all colour LEDs (red, green, blue, etc) may be used in all eight positions provided on the PC board while using just a single current-limiting resistor.

The Jazzy Heart really is jazzy. It needs to be seen to be appreciated – preferably accompanied with a fast disco beat to accompany it!

All eight LEDs essentially flash at random – but for fractions of a second, discernible patterns emerge. The LEDs may briefly whirl clockwise or anticlockwise, or bounce to and fro, sparkling in their water-clear encapsulations.

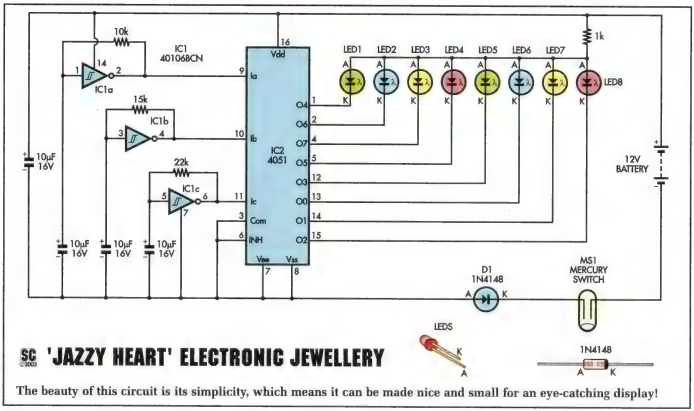
Circuit description

In concept, the circuit is very simple. At its heart lies a CMOS 4051 8-channel analog multiplexer.

This can be thought of a single-pole, 8-position switch, with the important difference that the 4051 allows random access to each of the eight switch positions.

This means that it does not need to sequence through each of the eight positions as a normal switch would do but has the ability to jump randomly from one position to the next.

Pin 3 is the centre or



SC 'JAZZY HEART' ELECTRONIC JEWELLERY

The beauty of this circuit is its simplicity, which means it can be made nice and small for an eye-catching display!

common pole of the switch, which is connected to any given switch position (numbered 0 to 7).

This is done by means of a three-bit binary number (or "word") which is presented to three "select" terminals (pins 9 to 11). The "select" terminals accept binary numbers from 000 to 111 and decode them to the eight separate switch positions.

Since only one 3-digit word can be entered at a time, only one of the output terminals can go "high" at any time.

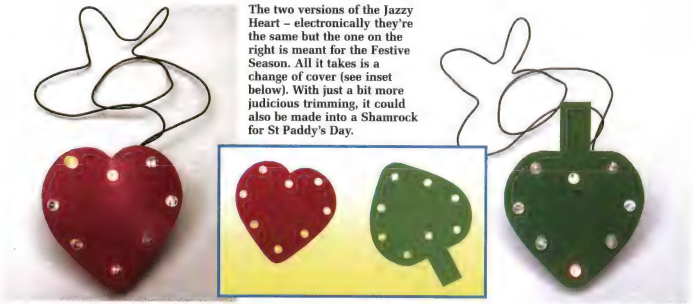
Each of the "select" terminals is fed separately by an oscillator running at about 5Hz. This means that each binary digit alternates between a binary 0 and 1 – independently of the other two binary digits.

Thus a practically random 3-digit binary word is generated, with the LEDs dancing more or less at random across switch positions 0 to 7, with fleeting patterns emerging.

Since pin 3, the centre or common pole in this circuit, is connected to 0V, each of the switch positions goes "low" when connected. Therefore the anodes of all the LEDs are connected to +12V, through a common 1kΩ current-limiting resistor.

Note that when a switch position is not connected to the common pole, the corresponding LED is disconnected from the power supply. This is in contrast with the 4028 CMOS IC, a BCD-to-decimal decoder, which serves a very similar function in digital circuits, but whose output terminals will only go "high" or "low".

Had a 4028 IC been used, the re-



The two versions of the Jazzy Heart – electronically they're the same but the one on the right is meant for the Festive Season. All it takes is a change of cover (see inset below). With just a bit more judicious trimming, it could also be made into a Shamrock for St Paddy's Day.

Parts List – Jazzy Heart

1 heart-shaped PC board, 63mm x 60mm, coded 08108031
1 Miniature mercury switch
4 10µF 16V electrolytic capacitors (or tantalums)
2 8mm crimp terminals for battery holder "end brackets"
1 Round head (No.2) paper fastener for battery holder negative terminal
1 red plastic sheet for Jazzy Heart fascia, 65mm x 65mm
1 green plastic sheet for Jazzy Christmas Tree fascia, 65mm x 65mm
1 5mm drill bit to drill plastic fascias (if required)
1 MN21, 23A or equivalent 12V (alkaline) battery
1 Suitable length of flexible wire or fishing line for "necklace"

Semiconductors

1 40106B hex Schmitt trigger (IC1)
1 4051B single 8-channel multiplexer (IC2)
1 1N4148 signal diode
2 5mm ultra-bright red water-clear LEDs
2 5mm ultra-bright yellow water-clear LEDs
2 5mm ultra-bright green water-clear LEDs
2 5mm ultra-bright blue water-clear LEDs

Resistors (0.25W 1%)	***4-Band Code (1%)***	***5-Band Code (1%)***
1 22kΩ	*red red orange brown*	*red red black red brown*
1 15kΩ	*brown green orange brown*	*brown green black red brown*
1 10kΩ	*brown black orange brown*	*brown black black red brown*
1 1kΩ	*brown black red brown*	*brown black black brown brown*

verse voltage across the LEDs would then have been 12V, which exceeds the rating (of typical LEDs). While the supply voltage could have been reduced to overcome this, the design could not then have accommodated all colour LEDs.

Each of the three oscillators, based on a Schmitt NAND gate, is very simple, requiring only one resistor and one capacitor. For the purpose of preventing "frequency lock" (the tendency of oscillators to "lock on" to one another in close proximity), the values of the capacitors are relatively large (10µF).

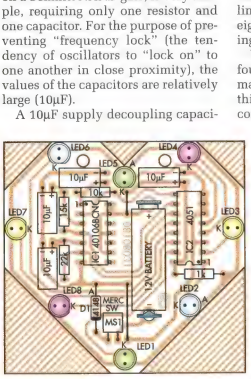
A 10µF supply decoupling capacitor is included for "good practice", although this is not strictly necessary.

For a less jazzy (that is, more sedate) display, increase the values of the capacitors, and vice versa.

Due to the relatively high supply voltage (12V), and since only one LED is flashed at a time, a single current-limiting resistor can be used for all eight LEDs combined, thus simplifying and compressing the circuit.

While it would be possible to use four or eight resistors, thus perfectly matching them to each colour LED, this would considerably increase the component count, and is not necessary in practice.

The result is an exceedingly compact circuit, using just over one component for each randomly flashing LED. Do note, however, that when selecting LEDs, the luminous intensity should be roughly the same – or test first with 12V and a 1kΩ ballast resistor.



Here's the PC board layout and the near-same-size photograph. Between the two of them you should have no assembly problems!

A miniature 12V battery is used (an MN21 or 23A or similar) and a 1N4148 diode is employed for reverse polarity protection. The reason why the diode is inserted in the 0V rail here is simply because this suits the circuit layout best.

A mercury switch was chosen to switch off the circuit, partly because a standard switch (even a miniature one) would have taken up considerably more space on the PC board.

With the mercury switch as shown, the circuit is switched off as soon as the PC board is laid flat or turned upside-down. The inhibit pin (pin 6) of the 4051 CMOS IC is tied "low". When this pin is taken "high", all switch positions are disabled.

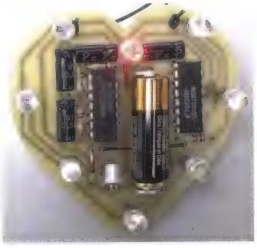
Finally, a question that is commonly asked about the 4051 is what purpose pin 7 (V_{EE}, or A/D) serves. When this terminal is tied "low", the IC will handle digital signals, as it does in the present circuit.

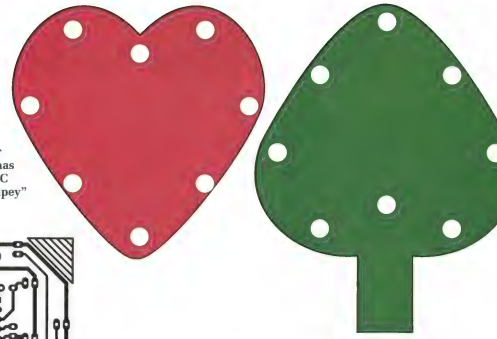
On the other hand, when analog signals need to be routed through the IC, this pin would normally be connected to the lowest voltage level in the circuit. So, for instance, pins 16 and 7 could be connected to +6V and -6V respectively, while pin 8 could be connected to 0V. Thus analog voltages of up to 12V could be handled with 6V digital control signals.

Assembly

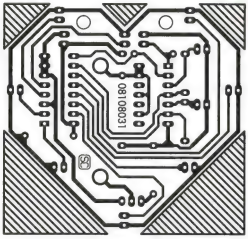
The Jazzy Heart is on a single PC board measuring 63mm x 60mm, and this is further cut and filed to shape as shown.

To begin, the battery holder is constructed of two round 8mm crimp terminals which are inserted into the holes provided on the PC board. In the prototype, a brass round head





Same-size templates for either the Jazzy Heart or the Christmas Tree. Below is the same-size PC board artwork. All of the "stripey" bits are trimmed off.



(No.2) paper fastener was inserted into one of the crimp terminals as shown and soldered into place, to accommodate the negative terminal of the battery.

Next, the resistors and capacitors are soldered to the PC board, as well as the 1N4148 diode and mercury switch. Be careful with the polarity of the capacitors and the diode.

Note that the mercury switch may need its legs to be raised a little, so that it is "off" when the circuit is laid on its back.

Then solder the two ICs, observing anti-static precautions (most importantly, touch your body to earth immediately before handling). Be quick with the soldering iron, so as not to damage the ICs. Alternatively, use dual-in-line (DIL) sockets.

The CD40106BCN IC is recommended for the oscillator section – other makes of the same IC may affect the "speed" of the Jazzy Heart. If other types are used, the capacitor values may need to be changed (probably reduced).

Solder the eight LEDs into place, noting their correct orientation (the "flat" on the encapsulation is the cathode). These LEDs are given fairly long legs, such that a "heart" or a "Christmas tree" template can be slipped over them after soldering. Thus they will just stand proud of the other components on the PC board.

Some ultra-bright LEDs are static sensitive, and anti-static precautions may need to be observed.

Finally, you may wish to attach a "necklace", which may be made from a flexible length of wire or fishing line inserted through the holes provided on the PC board and held with a knot at each hole.

Then fit the battery into its holder, taking care to insert it the correct way round. The Jazzy Heart should "fire up" as soon as it is vertical. When laid flat, it will "go to sleep".

Since the circuit draws a current of about 10mA, and the capacity of the specified battery is typically 33mAh, the Jazzy Heart should flash for three hours or more continuously before the battery is exhausted.

These 12V batteries can be expensive but we have found a very cheap source to be at bargain stores and markets, where you can often pick up a pack of two or three "no name" Asian imports for a couple of dollars or so.

If a "Christmas tree" template is used, the circuit will of course be positioned "upside-down".

In this case, the position of the mercury switch will need to be adjusted accordingly, so that the Christmas tree is "on" when it is stood **sp** vertically.

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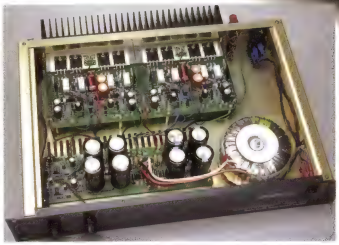
PRODUCT SHOWCASE

Elan RMA-02 Challenger studio monitor amplifier

Elan Audio is one of Australia's leading producers of professional audio equipment, widely used in recording studios and broadcast stations. Their RMA-02 stereo power amplifier, rated at 200W per channel is compact but does not have fan cooling, to ensure quiet running at all times.

The RMA-02 Challenger is the result of an interesting approach to producing a high power stereo amplifier for studio monitoring use. It is housed in a two-unit rack case and is fitted with 3-pin XLR connectors for its balanced inputs. Its speaker outputs are unbalanced and uses large binding post terminals. For lightness and corrosion resistance it uses an aluminium chassis and it weighs just 6kg all up. Separate volume controls are used for each channel, although we anticipate that in most applications (driven by a mixer) these would be set to maximum level. The only other control on the front panel is the on/off switch.



So while many studio monitor amplifiers tend to be big and bulky, the RMA-02 is quite compact. This has come about partly because the designer, Poul Kirk, has opted for a relatively modest power supply using a compact toroidal power transformer producing unregulated ±70V supply rails. This arrangement gives good headroom (ie, more music power on typical program). As such, it is intended for studio monitoring and high quality domestic installation. According to the designer, it is definitely not intended for disco, stage or sound reinforcement work.

The power amplifiers themselves use a fully symmetrical circuit, with complementary differential input stages, each with their own current sources. The output stage employs rugged 40MHz complementary bipolar transistors, considered by Elan Audio (and us!) to produce better quality sound than power Mosfets.

Possibly the most interesting aspect of the design is the use of a split feedback network with separate paths for high frequencies and low frequencies. There is heavy negative feedback at low frequencies, giving low distortion and high damping factor, as required for good low frequency loudspeaker performance. At the high frequencies, feedback is more moderate and this claimed to make the amplifier more tolerant of unpredictable loading effects of loudspeakers, crossover networks and speaker cables.

As a result of the above design philosophy, the power ratings are quoted as short term only, not continuous. Power outputs are listed as 200W RMS into 8Ω loads, 300W RMS into 4Ω loads and 400W RMS into 2Ω loads, although testing at this latter load impedance will blow the fuses. Harmonic distortion is listed at .015% or less at 1kHz at up to 100W and less than 0.5% at 10kHz.

Signal-to-noise ratio is -102dB unweighted (20Hz to 20kHz) with respect to 100W into 8Ω.Frequency response is very flat; 0dB at 20Hz, -0.1dB at 20kHz and -1dB at 40kHz.

We ran through the gamut of tests on the RMA-02 and confirmed every figure in the specs – that is a little unusual in itself. Even more satisfying were the protracted listening tests. Using a wide range of CDs, the RMA-02 always gives a good account of itself, with plenty of power, very low background noise and very clean sound at all times.

It would make an ideal studio monitoring amplifier (as intended), especially as it has no cooling fan.

Contact:
Elan Audio
2 Steel Court, South Guildford WA 6055
Tel: (08) 9277 3500
website: elan.com.au

BitScope USB digital 'scope, logic analyser & waveform generator

The BitScope BS300 is a high performance USB based dual channel DSO and Logic Analyser for use with Windows and Linux PCs. It has an input bandwidth of 100MHz and supports simultaneous analog and digital data capture at rates as high as 40MS/s. An integrated 10MS/s arbitrary waveform generator option is also available.

Standard accessories include 100MHz oscilloscope and high speed logic analyzer probes, USB interface, cables and power supply. The BS300 software integrates five powerful test intruments in one easy to use package: a DSO, Logic Analyser, Dual Channel Oscilloscope, Spectrum Analyser and XY Phase Analyser.

The range of options available include the built-in 10MS/s arbitrary waveform generator, an ethernet interface with full Internet connectivity, and expansion PODs. Additional software packages are also available.

If you have specialized test or data acquisition requirements, the full BS300 programming API is published allowing customized "virtual instrument" applications to be developed, and the BS300 POD interface provides full access to the analog and logic capture signals as well as data, control and power lines making the development of new BitScope powered POD devices easy.

Contact:
BitScope Designs
Tel: (02) 9436 2955
website: www.bitscope.com

Bluetooth Kits for Emona

Emona Instruments has been appointed the Australian distributor of the Teleca range of Bluetooth application development and training kits. Teleca is a Swedish based specialist Bluetooth R & D consultancy. Teleca's Bluetooth modules and Host Stack Software were developed by Ericsson, the owner of the Bluetooth trademark.

Teleca's range of Bluetooth kits are ideal for companies looking to build and test their own Bluetooth applications and products, as well as universities and colleges wanting to provide students with hands-on training in the theory and applications of Bluetooth short-range wireless communication.

Teleca's full-featured Development Kit is approved as a Blue Unit by the Bluetooth SIG, making it suitable in qualification and pre-qualification testing.

Contact:
Emona Instruments Pty Ltd
86 Parramatta Rd, Camperdown NSW 2050
Tel: (02) 9519 3933 **Fax:** (02) 9550 1378
website: www.emona.com.au

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AEMS acquires T&M equipment brokerage.

Australian Electronic Manufacturing Services (AEMS) have recently acquired the test and measurement brokerage (re-sale) business assets from Megatron.

AEMS is a Contract Electronics Manufacturer and Service Provider with over 550 staff located in 4 sites throughout Australia and New Zealand. (www.aems.net.au)

This acquisition provides AEMS with the Intellectual Property of the much-acclaimed equipment brokerage web-site developed by Megatron (now http://broker.aems.com). AEMS will continue to sell a vast range of used test and measurement and telecommunications equipment suitable for everybody from contractors and hobbyists to the professional technician.

AEMS have established an extensive display facility, which provides the capability for viewing equipment and performing on-site, basic functional testing of the units.

For items found to be faulty, AEMS will offer a repair service to ensure that items sold are fully functional.

AEMS Brokerage currently provides equipment disposal services for a number of Australian organisations. In addition, AEMS is in the process of expanding this portfolio of sources of used equipment and is currently offering its services to any company faced with the disposal of surplus test and measurement equipment. AEMS expects that any vendor utilising this service will achieve a far better return than the traditional method of disposal via auction.

AEMS has established an extensive database of overseas dealers and will continue to promote product to these whilst increasing exposure to Australian end-users.

Enquiries can be made to Alan Robinson (arobinson@aems.net.au).

Contact:
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Tel: (03) 9212 4222 **Fax:** (03) 9212 4020
brokerage website: broker.aems.net.au

USB-based data acquistion module

The USB-based Labjack U12 data acquisition and control unit is an easy-to-use plug-and-play USB device which operates completely under software control (no jumpers or switches to set) and no power supply is required. Up to 80 of the 100 x 150 x 25mm LabJacks can be connected to one USB port

It features eight single-ended, four differential 12-bit analog inputs with a ±10V range. With up to 8 kilosamples/sec (burst) or 1.2 kilosamples/second (stream), it supports software or hardware timed acquisition and triggered acquisition. It also features PGA with gains of 1, 2, 4, 5, 8, 10, 16, or 20V/V and has two 0-5V analog outputs, has 20 digital I/O (up to 50Hz per I/O) and a 32-bit counter.

The software packaged with the Labjack runs on Windows 98SE/ME/2000 and XP. It includes JLogger, a datalogging program; JScope, a virtual oscilloscope program; an ActiveX driver so you can write your own VB, Delphi and VB programs; sample VB and Delphi programs and Labview VIs.

Labjack U12's are being used for research, monitoring and control purposes in private companies and public organisations, universities and colleges.

Contact:
Ocean Controls
4 Ferguson Drive, Balnarring Vic 3926
Tel: (03) 5983 1163
website: www.oceancontrols.com.au

Logitech's new USB PC headsets

Logitech has released a new range of headsets that bring superior audio quality to people who want the best for voice chat, online gaming, music listening and speech recognition. Included in the range is a USB model as well as two conventional systems.

With an expected retail price of $89, the Stereo USB Headset offers advanced digital USB technology for superior audio clarity and the simplicity of a single USB plug-and-play connection. It has a noise-cancelling microphone and an adjustable headband engineered for a comfortable fit. The design allows microphone placement on either side of the head.

They are available from most computer products retailers.

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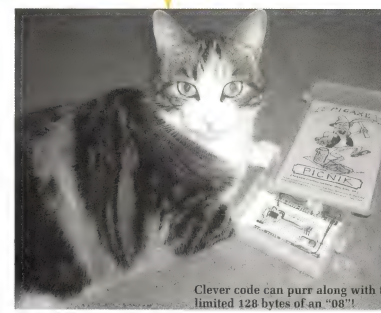
Get that fat cat code purring ...

by Stan Swan

In an era when even modest home PCs demand 128 *MEGA* bytes of RAM, the microscopic 128 bytes of Picaxe–08 memory seems almost laughable. To put this million times ratio into perspective, it's roughly akin to the price difference between a car and a peanut. Of course, with resourceful design, even 128 bytes may not be peanuts!



Clever code can purr along with the limited 128 bytes of an "08"!

Although PICAXE microcontrollers *don't* require solid programming skills, it's crystal clear to many users (myself included) that such devices, using " software to tame the hardware", look to be the future of many electronic circuits.

Most Picaxe designs (including mine) evolve under "cut and try" incremental programming, and parts drawer fossicking for, say 82nF capacitors and 680kΩ resistors in a traditional timing circuit, can be replaced by convenient and versatile code-tweaking instead.

Layouts can be smaller and cheaper too, and upgradable later without laborious unsoldering.

So – you want to be part of this "Flash" revolution then? You'd better take note of some basics!

If you yearn for more than simple "08" tone output or LED flashing, coding care and economy is obviously crucial. And it'll help develop good design habits that may carry over to larger microcontroller applications.

Many real-world electronic and software engineering projects, just as in other fields, are characterised by skills subdivision, such that teams may work on the display, while others may be slaving away with power supplies or user interfaces.

Ultimately these have to be seamlessly integrated into the final product, or much fist shaking and gnashing of teeth can occur. It's similar to building a house and coordinating tradesmen – of course you don't want concrete slabs poured before services like drains are first installed.

Perhaps the Golden Rule here is to

DOCUMENT YOUR CODING.

Such comments (indicated by ' before a remark) not only inform others about your actions, but allow *you* to be reminded about things when later (re)viewing your work.

These comments **do not** add to any program bulk, but **are** saved along with the program to your PC.

If you're a two-fingered typist re-entering programs by hand (rather than a copy-and-paste from a web page listing), comments don't strictly need to be included. Styles vary but it's common to add such 'remarks on the same line as the action.

Thus ***SLEEP 300*** *'enter low power sleep mode for 300 secs = 5 mins*

No doubt you've noted the initial preamble comments on our previous listings too.

These "abstracts" make for convenient spots for parts lists, authors, web sites, dates and versions – the latter point a crucial feature of course! Others may judge your skills by your comments, much as electronic projects are often judged by neatness of the hook-up wiring or PC board design.

Indenting a set of instructions, especially a loop, is also accepted practice since it quickly allows visual grouping. Using '—— spacers may help too.

Points so far are pretty much common sense but GOSUB/ RETURN – command pairs may need explanation.

LEDSOS.BAS (Also downloadable from: www.picaxe.orcon.net.nz/ledsos.bas)

```
'Switchable LED or SOS flasher for Aug 2003 SiChip PICAXE-08 article  V 1.0 26/6/03
'Connect 3 ultra bright white LEDs directly to PICAXE pins 4,2 & 1 + common ground.
'Switch to pin 3 may need pulldown  resistor (10 k ?) since tends to float high
'Just a single LED could be used, but 3 give greater light output even though each-
'-is actually lit sequentially & human "persistence of vision" perception exploited.
'Additional security results,since if 1 or 2 LEDs damaged or blown at least 1 works.
'No dropper R's as PICAXE 20mA source limit each pin is inside white LED 30mA specs.
'Extra driver transistor could be used to give ~100mA pulses?(Ref PWM "SiChip" 4/03)
'New command here =GOSUB,which allows common routine streamlining,thus memory saving.
'Maybe alter pulse duration,but 700 =7millisec seems highest flicker free pulse rate?
'Just 96 bytes used, so scope for other lighting effects- chasers/random/1-2-3 on etc
'Maybe "lost in the bush" beacon flasher once every 5 secs = prolonged battery life!
'3xAA batteries (4.5V) had ~16mA max drain when pulsed ~60 hrs life (& longer on SOS)
'       Via Stan. SWAN (MU@W,New Zealand)  => s.t.swan@massey.ac.nz <=
'Lines beginning ' are informative program documentation & may be ignored if need be.
'Program available for web download =>www.picaxe.orcon.net.nz/ledsos.bas
'Further "08" Morse ID refinements (35 chs !)=> www.picaxe.orcon.net.nz/morse.bas
'-------------------------------------------------------------------------------
ledtrio:                'routine to pulse all 3 LEDs to prolong battery life
if pin3=1 then ledsos   'if pin 3 switch is low(0) just "steady" light ouput
gosub pulse             'access common LED pulsed lighting routine
goto ledtrio            'loop back if switch set for steady light out still
'-------------------------------------------------------------------------------
ledsos:                 'emergency routine to send endless SOS .../—/...
 for b1= 1 to 3         'morse S = dit dit dit
  for b0= 1 to 4        'short hold on for each "dit" element
   gosub pulse          'access common LED pulsed lighting routine
   next b0              'loop to hold on duration variable
  pause 200             '200ms pause between each morse element
 next b1                'repeat so 3 flashes generated
pause 500               '1/2 sec delay between each morse character
'-------------------------------------------------------------------------------
for b1= 1 to 3          'morse O = dah dah dah
 for b0= 1 to 15        'longer pulse hold on loop for each "dah"
  gosub pulse           'access common LED pulsed lighting routine
  next b0               'loop to hold on duration variable
  pause 200             '200ms pause between each morse element
 next b1                'repeat so 3 flashes generated
pause 300               '1/2 sec (total) delay between each morse character
'-------------------------------------------------------------------------------
for b1= 1 to 3          'morse S = dit dit dit
 for b0= 1 to 4         'short hold on for each "dit" element
  gosub pulse           'access common LED pulsed lighting routine
  next b0               'loop to hold on duration variable
  pause 200             '200ms pause between each morse element
 next b1                'repeat so 3 flashes generated
pause 500               '1/2 sec delay between each morse character
'-------------------------------------------------------------------------------
pause 1500              '2 second pause between SOS sending
goto ledtrio            'recommence program from start
'-------------------------------------------------------------------------------
pulse:                  'subroutine to rapidly sequentially pulse all 3 LEDs
pulsout 4,700           'pulse pin 4   700 x 10 microsecs =7000us =7ms
pulsout 2,700           'pulse pin 2 (Perhaps try varying mark/space effects-)
pulsout 1,700           'pulse pin 1 (using high 4:pause 5:low 4:pause 50 etc)
return                  'go back to program point where subroutine began
```

These act as an elegant GOTO, and are seen as the heart of efficient structured programming, since they allow common routines to be referred to and actioned as need be, with a return back (to the next program line) on completion. It's similar to maybe "going on auto" when asked to put out the garbage while watching TV.

LEDSOS.BAS

The subroutine in the sample LED flashing program at left, giving out either a steady light or switched SOS, is called up as needed to give a common "pre-wound" pulsed LED instruction set rather than wastefully say the same thing three times elsewhere.

Pulsout commands here were selected to minimise circuit current drain, while giving the brightest light with the least flicker.

A Lux meter (eg, DSE Q-1400) may prove invaluable for this, since the human eye rather falls short when judging illumination changes.

As an aside from microcontrollers, ultra-bright white LEDs look to be the best lighting development in 100 years (and I'm related to Swan of 1880s carbon filament lamp fame too!) Their light output (typically now a dazzling 5600mCd for even "cooking" versions), almost unlimited life, ruggedness, high efficiency and (now) cheapness make traditional hot filament lamps near obsolete for portable work.

Although white LEDs typically draw 30mA at 3.6V, the 20mA Picaxe source limit allows them to be driven directly from output pins (here 4,2,1) at slightly reduced brightness.

A trio of driver transistors, as featured in the earlier pulse width modulation (PWM) motor controller, (SILICON CHIP April 2003) could perhaps boost this for brief 100mA pulses.

Note the new 10mm types used here give out no more light than normal

Any simple 2-wire conductor will pass Picaxe serial display data. Use the D9 pin 2 for the signal, with ground pin 5.

5mm types, but seem to "have more presence" according to one observer.

Being larger, they're much easier to find too – the transparent 5mm types are almost invisible when dropped on a carpeted floor!

Morse in the 21st century?

Although now very much the domain of amateur radio CW diehards, Morse code remains invaluable for beacon/lighthouse ID and emergency signalling – perhaps by flashing a (LED) torch or even knocking SOS on the wall. Hidden transmitter outdoor "fox hunts" sending Morse remain highly popular too.

More to the point for program economy insights, Morse dit/dah characters lend themselves to elegant analysis. Somewhat as a joint effort challenge (and inspired by an old BASIC Stamp program), Eric van de Weyer and I have managed to squeeze up to 35 Morse characters into an "08".

Without such "crunching", it'd be taxing to even fit "Leo" [·--- · ---] into 128 bytes !

Practising what I preach, the program listing overleaf (MORSE.BAS) is copiously commented, with even Morse characters themselves included for those who forget (or those who never knew them!).

Audio output is just from our piezo attached at pin 0, while the 10kΩ pull-up resistor fitted to pin 3 also remains. Driver transistors could be used to key a transmitter for more powerful work.

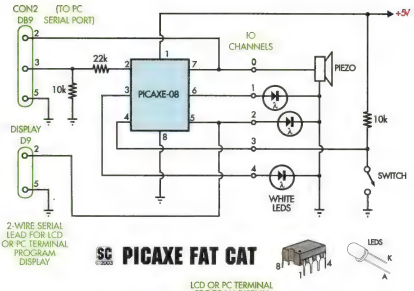
The SLEEP command used here, although only about ±1% accurate, causes a low power resting mode to be entered, which provides useful battery life extension. The syntax is obvious ex. SLEEP 60 will awake after 60 seconds, SLEEP 3600 after an hour

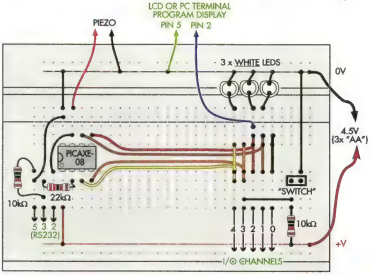
MORSE.BAS

Enough of the 19th century – we're in the Internet age. PICAXE serial data output (mentioned in the last article) also ends itself to message display. Although small LCD panels abound (mostly Hitachi-style 16 characters x 2 lines), these usually need driving with a **parallel** data stream.

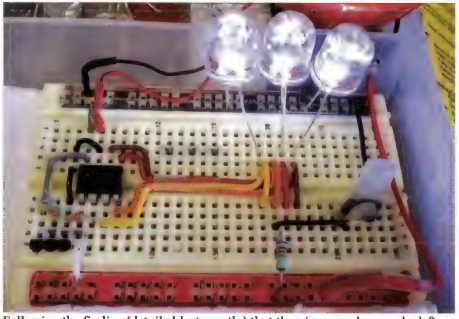
Logic ICs can be wired to provide SIPO (Serial In Parallel Out) shift registers, but these naturally may daunt users with simple display needs.

Several options have presented themselves, all of which will just need a simple 2-wire serial lead from the





Yes, it's the same old protoboard layout . . . or is it? That's right, it is now rather simplified. (The 10kΩ & 22kΩ resistors are only required during programming.)



Following the finding (detailed last month) that the piezo speaker can be left permanently attached to pin 0, the PICNIK box wiring has been adjusted to suit. The now idle jumper is here used to switch input 3 high or low via a 10kΩ pull-up resistor.

Picaxe output pin in use and ground return.

1. Purchase and assemble the Rev. Ed AXE033 LCD 2-part kit. (available in Australia and NZ from Microzed or their resellers). This comes with decoding electronics on board, plus a socket for a Real Time Clock (RTC) chip option that can be used to trigger program events.

Additionally up to 7 prepared messages can be organised and saved on this LCD board for easy recall– hence sparing the driving Picaxe the associated memory storage overhead. Yah!

If your project can stand the cost (A$44) this LCD certainly will greatly enhance it. However you'll need to have good soldering skills to assemble the rather fiddly kit (the instructions are microscopic!). A higher voltage 6V supply **will** also be needed, since the now-normal Picaxe 4.5V supply **will not** bring up the LCD image. Grr !

2. As an LCD workaround, the Programming Editor displays a mini serial terminal when F8 is pushed, using a signal lead (NOT the normal programming one) from the chosen Picaxe output pin and ground.

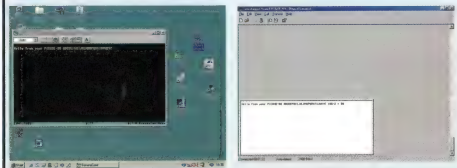
This display text is wider than the 16x2 LCD display, but may be valuable for initial display work. 2002 versions of the Picaxe Editor (Ver. 3.0.3) also offer a more graphical display when F9 is pushed

Close-ups of the AXE033 LCD kit. Note how the flexible solder mask strip must first be peeled away before inserting the header pins.

MORSE.BAS

(Also downloadable from: **www.picaxe.orcon.net.nz/morse.bas**)

```
'PICAXE-08 memory workout demo via Eric van de Weyer & Stan.SWAN  Ver 1.02 27th June 2003
'For Silicon Chip August 2003 PICAXE article.  Author - Stan.SWAN => s.t.swan@massey.ac.nz
'Ref. Edwin.C =>chick@chickene.freeserve.co.uk -June 2002 RSGB "RadComm" "28" version too
'Program (derived from a Basic Stamp-1 idea ) sends short repeating Morse Code ID message
'-------------------------------------------------------------------------------------------
'Almost unbelievably up to ~35 Morse characters can be stored in the tiny PICAXE-08 RAM !
'Output here just simple Piezo speaker at PICAXE Pin 0, but could be used to key a Tx etc
'Only other component needed = 10k pull up R  pin 3 to +ve rail to avoid "floating" I/O
'Note - although now near obsolete for messages,International Morse Code ( CW ) still has
'wide use for beacons etc since decoding can be via eye or ear,& even unskilled observers
'can thus "read" simple IDs & status at just a few (5?)words per minute.Of course sending
'SOS via torch etc still suits emergencies! Scouting days now long past?  Morse chs.are...
' A  .-       B  -...     C  -.-.     D  -..      E  .        F  ..-.
' G  --.      H  ....     I  ..       J  .---     K  -.-      L  .-..
' M  --       N  -.       O  ---      P  .--.     Q  --.-     R  .-.
' S  ...      T  -        U  ..-      V  ...-     W  .--      X  -..-
' Y  -.--     Z  --..     1  .----    2  ..---    3  ...--    4  ....-
' 5  .....    6  -....    7  --...    8  ---..    9  ----.    0  -----
' Full stop .-.-.-         Comma  --..--          Slash  -....-
'
'By tradition 1 dah/dash = 3 dits/dots with letter space = 3 dits & word spacing 7 dits
'
'How DOES this work !? Each ch.to be generated is programmed in as a number whose binary
'equiv. then generates the code ! The 5 MSBs(Most Significant Bits =LHS)represent dots &
'dashes, with dit=0 & dah=1. The last 3 LSB (Least Significant Bits = RHS) indicate how
'many elements in a ch. Hence V=00010100  (100 =4 elements). Bit 5 is meaningless here.
'Converting to decimal yields 20. Another ? K=10100011 = decimal 163 ( 011= 3 elements)
'Here's is a list of these characters (abrev. as ch. in comments) & their equiv. number
'-------------------------------------------------------------------------------------------
'A - 66      B - 132     C - 164     D - 131     E - 1       F - 36
'G - 195     H - 4       I - 2       J - 116     K - 163     L - 68
'M - 194     N - 130     O - 227     P - 100     Q - 212     R - 67
'S - 3       T - 129     U - 35      V - 20      W - 99      X - 148
'Y - 180     Z - 196     1 - 125     2 - 61      3 - 29      4 - 13
'5 - 5       6 - 133     7 - 197     8 - 229     9 - 245     0 - 253
'= - 141     / - 149     . - 86      , - 206
'
'Encode to suit - thus "AUSTRALIA 2003" = 66,35,3,129,67,66,68,2,66,0,61,253,253,29
'-------------------------------------------------------------------------------------------
'Copy & paste main program below to "08" editor via=> www.picaxe.orcon.net.nz/morse.bas
'Still scope for "telemetry" or tweaking SLEEP/NAP,as only 105 bytes (of 128)used as is!
'-------------------------------------------------------------------------------------------
```



Two terminal program screen shots, BananaCom & HyperTerminal, during the demonstration serial program run.

```
Symbol Tone = 100                 'sets the tone frequency ( range 20 -127 )
Symbol Quiet = 0                  'set quiet tone
Symbol Dit_length = 7             'set length of a dot    (7 milliseconds)- yields 10wpm
Symbol Dah_length = 21            'set length of a dash        (21 mS = 3 dots long)
Symbol Wrd_Length = 43            'set space between words (43 mS = 2 dashes, 6 dots)
Symbol Character = b0             'set register for ch.
Symbol Index1 = b6                'loaded with number of chs. in message
Symbol Index2 = b2                'counts the number of elements
Symbol Elements = b4              'set register for number of elements in ch.

Start:                            'NB - good program spot to turn on ID, via sensor etc maybe?
sleep 5                           '5 sec low power delay(varies if no pullup R)-modify to suit
if pin3 = 1 then Identify         'wait for high input on pin 3 to start message- 1 by default
goto start                        'if no input,loop to start.

Identify:                         ' routine to lookup ch.& put its value into the ch. register
  for Index1 = 0 to 27            'cycle through lookup for times = number of ch. in message
lookup  Index1,(3,2,68,2,164,227,130,0,0,164,4,2,100,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1),Character
' This means (S I L I C O N C H I P dit dit dit etc
gosub Morse                       'go to the ch. generation routine
  next                            'loop back to get next ch. and load it
  goto Start                      'return to start to wait for next input

Morse:
let Elements = Character & %00000111      'look at 3 LS digits and load into Elements register
if Elements = 0 then Word_sp              ' % means binary

Bang_Key:
  for Index2 = 1 to elements      'loop through correct no. of times for number of elements
  if Character >= 128 then Dah    'test MS digit of ch. If it is 1 goto the Dah sub routine
goto Dit                  'if it is 0 goto the Dit sub routine

Reenter:
  let Character = Character * 2   'do a left shift on all the bits in ch.
  next                            'loop back to get the next element
  gosub Char_sp                   'go to sub routine to put in inter-ch. space
return                            'return to Identify routine to get next ch. to send

Dit:
sound  0,(Tone,Dit_Length)        'sound tone for dit length
 sound 0,(Quiet,Dit_Length)       'silence for dit length
goto Reenter                      'return to look at next element of ch.

Dah:
sound  0,(Tone,Dah_Length)        'sound tone for dah length
 sound 0,(Quiet,Dit_Length)       'silence for dit length
goto Reenter                      'return to look at next element of ch.

Char_sp:
 sound 0,(Quiet,Dah_Length)       'send silence for dah length after ch.completely sent
return                            'return to get next character

Word_sp:
 sound 0,(Quiet,wrd_length)       'send silence for break between words
return                            'return to get next ch.
```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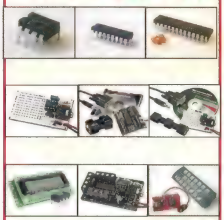

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oatleyelectronics.com

References and parts suppliers . . .

(also refer to previous months articles)

1. Ultrabright (white) LEDs 5600mCd range ~A$3 – various suppliers:
   Jaycar www.jaycar.com.au
   Dick Smith Elect. www.dse.com.au
   Altronics www.altronics.com.au
   Oatley www.oatleyelectronics.com
   etc

2. Lux meter – Dick Smith DSE Q-1400 (~A$100) www.dse.com.au

3. Australian Picaxe agents, MicroZed, handle the AXE033 LCD kit & RTC ($44) as well as Picaxe chips www.picaxe.com.au

4. A superb example of a well documented Picaxe program can be seen at www.hippy.freeserve.co.uk/axe18-mon.txt

5. Banana Comm Terminal Program (shareware ~160k) Download from www.picaxe.orcon.net.nz/bcom30.zip

5. StampPlot Lite Ver 1.7 Shareware (~1.6MB)- now handles 2400bps OK. Download www.selmaware.com

5. Author's revamped site with many links & usual demo program downloads www.picaxe.orcon.net.nz

TERMDEMO.BAS

```
'For Aug."SiChip" display article.  Stan. SWAN =>s.t.swan@massey.ac.nz  Ver 1.0  19/6/03
'Picaxe serial output demo for PC VDU display via almost any datacomms terminal program
'Many exist,espec.classic Windows HyperTerminalPE (~700k) via =>www.hilgraeve.com .Free!
'Install it then run - properties - make session -"Connect- Direct to Com1" & 2400,8,N,1
'Consider cheap 90s laptops/organisers too -Compaq Aero/HP 200LX & Sharp Wizard 7xx etc
'DOS (but Win friendly) Banana Comm (~170k) espec.clean,& MODE CO40 allows enlarged text
'Also works on Rev.Ed AXE033 16x2 alphanum. LCD kit,but text wraps since smaller display
'Easy 2 wire serial only,here via "08" I/O pin 2 then D9F pin 2 for PC COM1 + pin 5 gnd
'Suggest using 2 PCs for this - one as normal programmer, & other just for serout display
'Program(s) can be downloaded =>www.picaxe.orcon.net.nz/termdemo.bas,& also /bcom30.zip
'2 notebook setup pix (Toshiba editor/Aero display)=>www.picaxe.orcon.net.nz/termdemo.jpg
'NB-when Editing + 2 wire serial lead to correct I/O pin- F8 gives "mini terminal"
'Even "datalogging" possible (via "F9" under Editor V 3.0.3 ) or via StampPlot Lite 1.7 !
'_____________________________________________________________________________

demo:                                        ' ASCII control codes <32 are IBM style
serout 2,n2400,(12,10)                       ' Form Feed (FF)=clear screen- then a LF
pause 50                                     ' brief pause before message shows
serout 2,n2400,("Hello from your PICAXE-08")  ' displays message in quotes
serout 2,n2400,(32)                          ' acts on ASCII directly - a space
pause 500                                    ' 1/2 sec pause for visual effect
for b0= 65 to 90                             ' / acts on direct ASCII request
serout 2,n2400,(b0)                          '  so translates & displays
next b0                                      ' \ A - Z characters in sequence
pause 2000                                   ' 2 second delay to hold message
b2=100                                       ' assign demo variable value
b1=b2/2                                      ' simple divide 100 by 2 maths calc.
serout 2,n2400,(32,#b2,"/2 = ",#b1)          ' space,then calc.(# forces values)
pause 1000                                   ' 1 sec. pause
goto demo                                    ' repeats entire message
```

3. Given the abundance of older discarded notebook PCs, it's tempting to raid the broom cupboard, dust one off and push into service running a Terminal program. Numerous compact organisers, such as the HP-200LX and Sharp Wizard OZ/ZQ 700 range, also came with inbuilt terminal programs but these may not stoop to the Picaxe 2400bps limit.

Programs found to give seamless displays were the classic but bland Windows "HyperTerminal", a tiny DOS (but Windows friendly) "BananaComm", and the astounding StampPlot Lite.

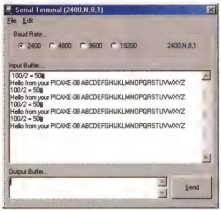
This latter program not only shows normal messages, but handles comma separated value data (.csv – as used with Excel), with graphical display. Although initially written for the BASIC Stamp, StampPlot works with any serial data stream- the US author even kindly tweaked it for 2400bps Picaxe use!

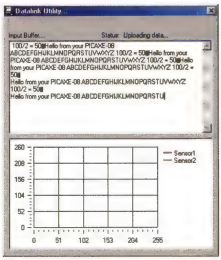
Compared with the AXE033 LCD, a full PC terminal program like BananaCom allows both a wider screen and larger text (via MODE CO40), ASCII control codes (such as CR/LF) plus saving and printing etc. With a small computer like the 1993 Compaq Aero used here, this approach may be a versatile "zero cost" display solution.

The TERMDEMO.BAS demonstration serial data Picaxe program needs no external hardware beside the serial output cable. It simply displays a repeating message to whatever terminal program (or LCD) you've connected via the 2 wire lead.

Note how # forces actual result variables (rather than just messages) to also be displayed too.

You'll no doubt quickly tire of irksome cable swapping when exploring display syntax effects, so it's (again) suggested that two (notebook?) PCs be used – one for editing, and the other as a display terminal. Good viewing! **SC**





Screen shots during a program run of the Programming Editor's F8 and F9 serial data "terminals".

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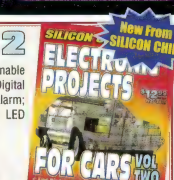


Over the years, SILICON CHIP has presented many timers – they are amongst the most popular of school projects. Here's how a reader "made" a timer for a darkroom enlarger – the parts are readily available from council cleanups or rubbish dumps!

Words by Ross Tester
From an idea (and photos) by Jess Benning

For what they do – basically, turn an enlarger lamp on for a certain (controllable) time and back off again, darkroom timers are very expensive beasts.

Perhaps part of the reason is that the popularity of do-it-yourself photo processing is nothing like it was in years gone by – hence less timers are made – but that doesn't change the fact that they are expensive.

Come to think of it, they have always been pretty exe!

Yet timers *per se* are now made in (probably) the hundreds of millions every year. Just about every commercial appliance these days seems to have a timer of some sort. Just take a look around you. They're everywhere!

Which leads us directly into this article...

One of our readers, Jess Benning, was asked by a workmate to make an economic enlarger timer for her daughter, who was studying photography at school.

"Too easy," he thought. "A microprocessor controlling a transistor switching a relay . . ." Then he added up the cost. By the time added a power supply and put it in a suitable box, it would probably be a good fifty dollars or so. Surely there was a cheaper way?

With that thought in the back of his mind, he forgot about the project for a few days; that is, until he happened to visit a recycling centre at the local tip.

There, sitting on the shelf, were several microwave ovens, all with inbuilt timers. "What's that? Timers? I wonder if . . ."

People mainly throw out microwave ovens for two reasons. The obvious one is that they don't work – or at least they don't heat (more often than not it is a relatively simple fix but we won't go into that – microwave ovens are lethal devices).

The less obvious reason is that the microwave oven still works perfectly – but they have broken the (usually glass or ceramic) platter.

If you have ever tried to replace one of those as a spare part, you'll know what we mean when we say it's often more economic to buy a whole new microwave oven!

Back to our story: if the microwave oven doesn't heat, it's usually the high voltage supply which has failed. Sometimes it's the magnetron but that is much less likely. But the timer, powered by its own low voltage supply, usually still works.

"The timer . . . still works?" You're probably one jump ahead of us, right? Of course – use the microwave oven timer as an enlarger timer.

All you have to do is find a suitable microwave oven!

Wait! They're dangerous!

But hang on a sec: didn't we say a minute ago that microwave ovens are lethal devices?

Yes we did – and for that reason we are going to say very clearly: **NEVER take the lid off a microwave oven and apply power (or work on a live one!).** Even if the magnetron is not working, you have a high voltage mains transformer which can very easily kill (and indeed has done so in the past).

Please read that last paragraph again, out aloud.

Even qualified technicians don't like working on microwave ovens because they know just how dangerous they can be – the 5000VDC or so high tension of a microwave is dramatically more dangerous than the 20-30,000V high tension of a colour TV set. The difference is the microwave high tension is designed to supply real current!

Here's a tip. If (as we are doing here) you want to "rat" the timer from a microwave oven, once you've established that the timer section still works (ie, the display works), unplug the oven and then cut the mains cord off. That way, you (or someone else) won't be caught dead. Literally.

Even then, a microwave oven is not 100% safe. We'll look at other precautions you should take with a "dead" microwave oven shortly.

What's in a microwave oven?

We're getting a little ahead of ourselves here. Let's go back and have a look at a typical microwave oven. Inside, there are six main parts:

1. low voltage power supply
2. timing circuitry / display / keypad
3. high voltage power supply
4. door interlocks
5. magnetron
6. light, fan(s) and platter motor

All that is needed for this project are parts 1 and 2 – and yes, they are quite easily distinguishable. Or more to the point, the high voltage components and magnetron are very easily distinguishable – you need what is left.

Incidentally, if you cannot readily work out which bits are which in the microwave, you shouldn't be attempting to reproduce this project.

The microwave oven was bought for $15.00 from "Revolve" (the recycling centre at the local tip. Pretty apt name for selling microwave ovens, eh?).

A relatively late model Sharp was chosen because the timer gave a couple of nice features: a digital clock (of course!) which you could see in the dark and an "auto start" function which was intended to turn the oven on for one minute – a feature which would be very handy for focussing.

Here's the pushbutton control pad as removed from the microwave oven. It is a pretty simple job as long as you are careful with the flexible keypad and ribbon cable. Almost hidden inside the box, alongside the transformer, is one of the two relays from the microwave oven: this switches power to the enlarger lamp supply.

Even dead microwaves can bite!

The magnetron power supply basically consists of a high voltage transformer (circa 3000V AC), a diode and a capacitor, yielding about 5000V DC.

Usually there is some form of control to vary the proportion of time the magnetron is turned on, thus varying the output power. It's pretty simple.

But there is a catch for young (and not-so-young) players. The capacitor can sometimes retain its charge for a very long time after turn-off.

In many (most?) ovens there is a bleed resistor across the capacitor to help discharge it after turn-off but there is no guarantee that the resistor has done its job or is even still intact.

If the bleed resistor is open circuit, (or non-existent) the high voltage capacitor could still easily have several thousand volts on it days, weeks or perhaps even months after its last use.

Such a high level of charge could still be lethal, or at best give you a very nasty bite.

It's not just uncomfortable – the shock can make you suddenly jerk your hand away and possibly jag it on some close metal. Trust us, it happens.

The moral of this part of the story is to never trust a microwave oven power supply, dead or alive. Again, let's reiterate – NEVER poke around a live microwave oven and be extremely careful poking around a dead one.

We would ALWAYS discharge the high voltage capacitor before working on a microwave. The most usual way to do this is to short out the terminals with a large, well insulated screwdriver (note we said the most usual way, not necessarily the best way!). Beware the risk of bits of molten metal flying off if

Fitting the timer into a case: this was nice and easy. A suitable cutout in the lid lets us read the display, while the pushbutton control pad was transferred to the case lid complete with its multi-way flexicable. The photo at right shows the finished project, complete with the (red) mini power outlet fitted to the side of the case. All you have to do is punch in the time required, hit "start" and voila!

there is significant charge. Of course we would always wear insulated gloves and a pair of goggles doing this.

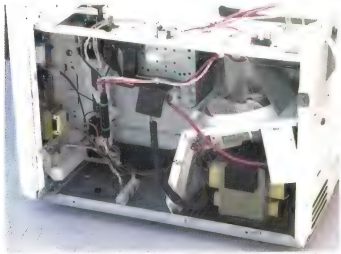
And here's yet another trap for young players: you've discharged the high voltage capacitor and then left the microwave for, say, a couple of days. You touch the capacitor terminals and get a real bite!

What can happen is that the charge can build back up again over time – and it could be several hundred volts or so. To prevent this, a clip lead should be used to short out the capacitor terminals, once discharged.

What to do now?

OK, so you've made sure the oven is off, the power plug is disconnected and (preferably) the lead cut off. You have also made sure that the high voltage capacitor is discharged and cannot recharge or be touched.

Now you have to identify the low-voltage supply and timer circuit. Fortunately, this is usually fairly easy: it almost always has a separate (much smaller) transformer and power supply and you will probably find in most microwave ovens the timer circuitry is modular – often directly attached to the display/timer settings (but if not, certainly connected via a wiring loom or ribbon.)



Inside a Sharp microwave oven. The high voltage supply is under the white cover. The wanted timer and control circuitry is clearly separate on the left side.

Inside the microwave, there are usually two relays – one controls the magnetron and the other the turntable motor and blower fan (if fitted). Because these are both controlled by the timer circuit, you should be able to use one of these relays virtually "as is" to control the enlarger lamp.

It's then simply a matter of connecting the relay contacts so they switch the enlarger lamp supply.

Because the low-voltage supply is mains powered and in all probability the enlarger lamp supply is also run either directly off the mains or via a mains power supply, the timer/display/relay assembly should be mounted in a suitable case to make it completely safe. Our reader also chose to fit a small mains outlet to the side of the case to make it all self-contained – that is entirely up to you.

Not all of the keypad is used – only the digits and "start" buttons are really needed. Other oven-specific keypad contacts which are not used can be left out.

The oven selected had a semi-flexible keypad. When fitting the keypad, to be able roll the unused pads up, the layers of backing need to be removed. To make it able to be rolled up the stiff layer should be cut and removed.

To stop the unused buttons from staying on permanently once you roll up the unused bit, the carbon conduction layer needs to be removed and some contact or tape put over the switch layer to stop it from shorting to anything else.

If the LED display is too bright for your darkroom, it's quite easy to layer the display with filter film and cut it back to an appropriate level. That is much easier than trying to dim the display.

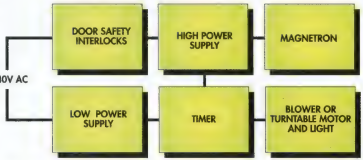
Of course, this timer (which can be set to 99 minutes and 99 seconds) doesn't have to be used in the darkroom. It's handy for a wide variety of mains-powered timing applications.

How does a microwave oven work?

Most people are aware that microwave ovens cook or warm food very quickly. But just how do they do it?

Let's look at the easy part of the answer first. Microwave energy inside a microwave oven excites molecules of water and fat (which are present in practically all food). As the molecules get excited, they give off energy – in the form of heat. Excite the molecules enough and collectively they give off enough energy to warm or cook the food.

Microwave energy doesn't penetrate the food very deeply – and in many foods penetrates to different levels. That's why you can get food cooked on the outside but not on the inside. However, a microwave oven normally does do a better job than a standard oven which cooks from the outside in, by conduction.



Basic arrangement of a typical microwave oven. Microwave output from the magnetron is stirred up and fed into the oven chamber where it interracts with the water and fat molecules in the food, result in heat and cooking.

Incidentally, the air inside a microwave oven is only marginally above room temperature. Therefore it plays no part in the heating/cooking process (unlike a conventional oven, where the air is heated).

And microwave energy does not affect most plastics, glass, ceramics, etc (although some may have additives which *are* affected). That's why you can usually use these materials in a microwave oven without their melting!

How do the microwaves get there?

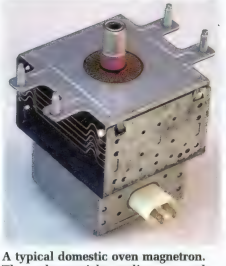
Microwaves are a type of radio wave; a super high frequency radio wave. They are generated by a special type of vacuum tube diode called a magnetron.

In the tube, electrons are emitted by a heated cathode and, being negatively charged, are repelled by the negatively-polarised cathode. Instead of travelling straight towards the positively-polarised anode (as in a normal diode tube) the electrons are deflected by the magnetic fields of very powerful magnets around the device (hence its name, magnetron).

They actually start to spiral, or spin, towards the cathode. Now the anode in a magnetron is not a plate, like a diode – it is in fact a number of high-Q resonant LC circuits, called cavities, effectively connected in parallel.

What happens when a resonant LC circuit intersects the path of an electron flow? It generates an electromagnetic field – radio waves, if you like – in this case, at microwave level (the actual frequency, usually about 2.4GHz, is controlled by the cavities).

The magnetron has a small transmitting antenna, designed to radiate the microwave energy from the cavities at maximum efficiency. But the microwaves aren't allowed to get out into free space. They are collected by a waveguide and "piped" into the microwave oven, itself designed for maximum efficiency at microwave frequencies.



A typical domestic oven magnetron. The socket at right applies power; the cylinder at the top is the antenna.

Because microwaves tend to travel in straight lines, they need to be "stirred" to ensure they cover every nook and cranny of the oven. This is done with either a fan in the microwave's path, or by turning the food to be heated on a turntable or in many ovens, both.

Finally, a system of door interlocks ensures that if the door is opened while the microwave oven is on, power is immediately cut to the magnetron to avoid cooking anything else (or anyone else) in front of the door.

Who invented the microwave oven?

The correct answer is no-one!

The effect was discovered quite by accident just after the second world war when a radar engineer at Raytheon Corporation, Dr Percy Spencer, noticed that a candy bar in his pocket melted when he was experimenting with a relatively new kind of vacuum tube (you guessed it, the magnetron). He tried placing popcorn kernels near the tube – and they promptly started popping.

The magnetron, by the way, was invented back in 1940 by two English scientists as a major (and successful) component of the Allies' radar system during the war.

Next day, Spencer was demonstrating this to a colleague by placing an egg near the tube. If you've ever placed an egg in a microwave oven, you'll know what happened next: it exploded – cooked – all over the colleague!

Dr Spencer then made a metal box, into which he directed all of the microwave energy. Unable to escape, the density of microwaves became even greater and food placed in the box cooked quickly. The microwave oven was "born", even though it took some twenty years before the first domestic microwave oven was released.

Now you'd be hard-pressed to find too many homes in the developed world without one! SC

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

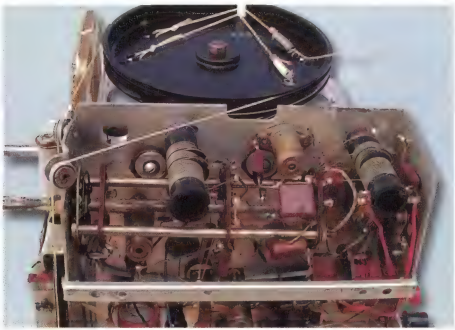
The HMV 42-71 migrant special

Dual-wave radios were popular in Australia in the years following World War 2 but many of them were poor performers on the short-wave bands. However, there were quite a few exceptions, including the HMV 42-71.

When World War 2 came to an end, many thousands of people in Europe migrated to Australia. And naturally, many of them were quite homesick for news from their home country.

During that era, many dual-wave radios were bought by Australians and by a large number of "New Australians", as they were called at that time. However, the majority of these dual-wave radios just couldn't cut the mustard when serious shortwave listening was contemplated and listeners were usually very disappointed.

So where did those radios fall down in their performance? There were several factors at work here. First, their tuning was ultra-critical, particularly up around the 17MHz end of the band, where simply touching the tuning control was usually enough to cause the receiver to tune off the station. The fact that shortwave stations are spaced at 5kHz intervals, compared to 10kHz for broadcast stations, didn't help matters either.



This under-chassis view of the HMV 42-71 clearly shows the shortwave coils (wound with tinned copper wire), together with the band-change switch.

The sets were insensitive too, with a sensitivity figure of about 30μV for a 5-valve AC receiver being common. Dual-wave 4-valve AC sets were even less sensitive. In fact, it was almost a complete waste of time fitting shortwave to these sets!

So why were shortwave bands fitted to these sets when their performance was questionable? I don't know for sure but I suspect that it was a selling point to have shortwave so that you could listen to the BBC in London or other stations in Europe, or the shortwave service for inland Australia.

It sounded exciting at the time but the excitement soon waned when the deficiencies of the receiver became painfully obvious. It really was an expensive gimmick.

However, radio manufacturers eventually realised that a considerable number of listeners really did want to listen to shortwave. They also wanted to be able to tune each station easily and they wanted receivers with greater sensitivity.

There were several ways that the problems could be addressed and we'll take a look at some of the methods employed.

Performance tweaks

AWA's 7-band, 6-valve receivers (see May 2001 and March & April 2002 issues) achieved an easy tuning rate on shortwave by having six shortwave bands to cover from 1.6-22.3MHz, with a maximum of 6MHz tuned in any one band. Tuning did have to be precise with these sets but it was still far superior to the tuning on sets that tuned 6-18MHz in one sweep.

The sensitivity of these AWA sets was very good too thanks to the inclusion of a tuned radio frequency (RF)

stage. This improved the reception markedly compared to sets without an RF stage.

Most people weren't particularly interested in listening to frequencies outside the international broadcasting bands. Bands which had shipping, bushfire brigades, radio amateurs, weather forecasts, etc were of no real interest to these people.

A number of manufacturers decided that they would provide bandspread tuning on a selected number of the international shortwave bands. In fact, some sets were designed to tune just one band per switch position.

In practice, there are 12 international bands, ranging from the 120-metre band covering 2.3-2.5MHz to the 11-metre band covering 25.6-26.1MHz. However, the frequency range tuned in each band has varied over time with international agreements, so the frequencies quoted above may not now be 100% correct.

The most common bands tuned were the 49, 41, 31, 25, 19 and 16-metre bands, although not all of these were included in post-war multi-band receivers.

Some receivers tuned two international bands per switch position and the HMV 42-71 described here (and its rebadged stable-mate the Kelvinator 42-K) did just this. Its tuning ranges on shortwave are 5.9-7.5MHz (which includes the 49 and 41-metre bands), 9.4-12.1MHz (which includes the 31 and 25 metre bands), and 14.2-18.4MHz (which includes the 19 and 16-metre bands). Its dial drive is not as smooth as on the AWA "7-banders" but it tunes slightly smaller band segments so tuning is not a hassle.

RF stage

Most of the receivers built to provide good reception of international broadcasting stations included an RF stage to boost sensitivity. However, it appears that HMV were looking to cut costs and so they settled on a receiver with a 6AN7 converter and no RF stage.

The 6AN7 is a quiet converter compared to the noisy 6BE6, so front-end noise was not a problem. In addition, the audio amplifier has more gain than normal and this was achieved by using a 6N8 pentode instead of the more commonly used triode as the first amplifier.

As a result, HMV was able to produce a receiver that could do a credible job at a reasonable price. Let's take a closer look at this unit.

The HMV featured three shortwave bands (plus the usual broadcast band) and was housed in a large bakelite case. The case was cleaned using automotive cut and polish and now looks almost new again.

The HMV 42-71 mantel radio

The HMV 42-71 came onto the market in 1954 to serve the needs of Australia's ever increasing migrant population. It sported the broadcast band and three bandspread shortwave bands, plus an input for a record player.

Basically, it was aimed at the lower end of the market for those people seriously interested in listening to international broadcasts. However, that does not mean that it is a poor performing receiver – quite the opposite, in fact.

Fig.1 shows the circuit details of the receiver. The input circuit is similar to many other HMV multi-band sets, with the shortwave antenna/aerial coil primary in series with the broadcast band coil primary. There is an IF trap (L1, C1) between antenna and earth.

The shortwave coils are tapped to suit the band being tuned. Note that in order to achieve bandspread tuning, several capacitors (C5, C6, C7 and TC2) are switched in series and parallel with each tuned circuit. The oscillator tuned circuits also use similar parallel and series combinations of capacitors to achieve band-spreading. The 6AN7 "frequency changer" converts the incoming signal down to 455kHz – ie, to the intermediate frequency (IF).

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This rear chassis view shows the uncluttered layout of the receiver. Access to the valves and to other parts on the top of the chassis is quite easy. Note the large U-shaped brackets at either end of the chassis – these make servicing easy, since they support the chassis whem it is turned upside down.

Next in line is a 6N8 and this acts as a neutralised intermediate frequency (IF) stage at 455kHz. Delayed automatic gain control (AGC) is developed from the signal at the plate of the IF valve and is applied to both the IF and converter stages. After detection, the signal then goes through a switched tone control to the grid of a 6N8 audio valve.

When set to the "Bass and Top Cut" position, the tone control modifies the audio so that speech passes through normally, while music signals will be devoid of highs and lows. Other positions give normal wide-range audio and audio with varying degrees of tone top cut. This helped listeners get the best out of the receiver in difficult listening environments.

As mentioned before, the 6N8 audio stage has higher amplification than the usual triode audio stage. Its output is fed to a 6M5 power amplifier stage. Feedback is achieved via the voice coil to C33, the 6N8 screen bypass capacitor.

The audio output transformer (T2) is larger than usual and the speaker is a substantial 6 x 9-inch unit, so the audio quality is much better than from the average mantel receiver. However, this set would need a rather large mantelpiece as it is far from small. That said, the lack of miniaturisation has helped to give the set an air of quality and performance.

The power supply is conventional and uses a 6V4 rectifier which has higher ratings than the commonly used 6X4. Back bias is used to delay the AGC and to provide a fixed initial bias on the converter and IF valves. The 6M5 also receives back bias, while the 6N8 audio stage has its cathode biased via R16.

Note that because the cathode of the 6N8 has no bypass capacitor, there is negative feedback which improves the audio quality and stability of the audio stages.

Restoring the cabinet

My HMV 42-71 radio receiver was offered to me in a very bedraggled state several years ago. At the time, it looked interesting, was fairly large and had several bandspread shortwave bands. And it certainly looked like it could do with a good home. It was covered in dust, the cabinet was dull, the knobs were missing and the inside was covered in a thick layer of white dust from the feed in the cowshed in which it had been sitting for many years!

What a place to have such a set – it must have been used to serenade the cows while they were being milked! Mice hadn't done much damage but someone (presumably a rat) had soldered metal extensions (in the form of bronze welding rod) to the control shafts to make it possible to operate the set without its knobs. So it wasn't in very good condition when I acquired it.

Naturally, I had to remove the bronze welding rod "controls" before I could extract the set from its case. It was also obvious that the original back had been broken as a quite different back had been fitted, although the screw holes all lined up OK. It was obviously another HMV cabinet back

but not the one specifically designed for this receiver.

The back was easily removed by undoing four screws, after which the set was placed face-down on a blanket so that the four screws holding the chassis to the case could be removed. However, when I tried to extract the chassis, something seemed to be holding it in place. A closer inspection revealed that there were two screws and clamps that held the edge of the speaker baffle in place. These were loosened, the clamps moved to one side and then the chassis slid out of the cabinet quite easily.

That done, I gave the cabinet a good bath in the laundry tub, using dishwashing detergent and a small scrubbing brush. It was soon clean. I then gave it a good workout using automotive cut and polish and it came up looking almost like new (for more on restoring bakelite cabinets, see my article on this subject in the July 2001 issue of SILICON CHIP).

Unfortunately, I didn't know exactly what the original knobs looked like so I used some that I had which appeared to suit the set.

The speaker grille was a light coloured plastic perforated panel attached to the speaker and chassis. It looked disgusting, being covered with grime from its time in the cowshed. I cleaned it in the same way as the cabinet but because there are so many nooks and crannies in its construction, I couldn't get it thoroughly clean.

In the end, I decided to remove it from the set and give it a couple of coats of gold-coloured enamel spray paint. This went on well and it looked a million dollars compared to its original state.

Before doing this, however, I removed the HMV emblem and polished it with the auto cut and polish and it now looks first class. Finally, with the cabinet and speaker grille looking so good, it was time to attack the chassis and the electronic circuitry.

Restoring the chassis

First, the valves were removed and the chassis was cleaned with a brush. Alternatively, if you have an air compressor, it can be blown clean. However, if using an air compressor, be careful not to damage the tuning gang vanes or get "muck" stuck between the vanes.

Having got the loose muck off, it was time to scrub the chassis as best I could. I used the end of a file to scrape the thickest debris off the chassis, then used a kerosene-soaked kitchen scouring pad to work on the rest of the muck. It was a long job and even when

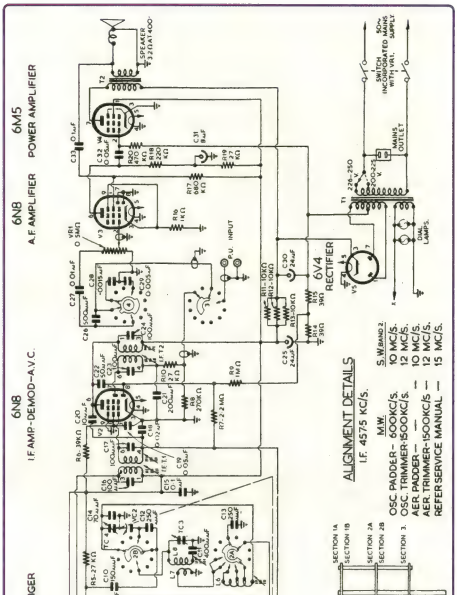
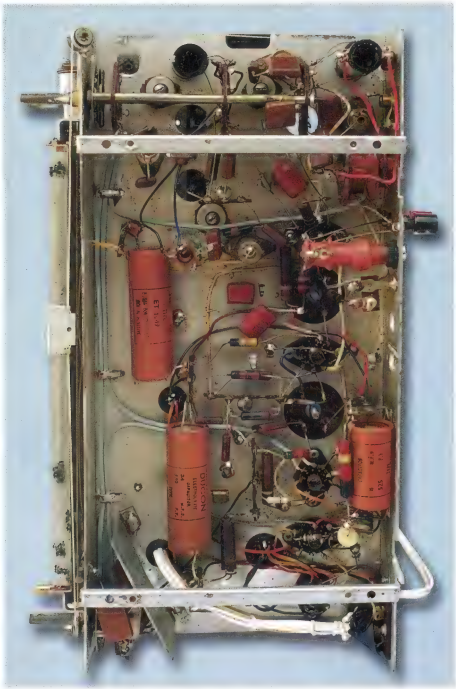


Fig.1: the HMV 42-71 is a fairly conventional 5-valve dual-wave receiver. There's no RF stage but the 6N8 audio stage has higher amplification than the usual triode audio stage.



The under-chassis wiring is uncluttered and all parts are easy to access, even around the band-change switch at top.

the chassis was clean it was not in a pristine condition. There were patches of discoloration where rodent urine had eaten through the plating.

I was in a quandary about whether I should leave the chassis as it was – clean but not pristine in looks – or paint it. This was one of my early restorations and I thought I'd have a go at painting the chassis with aluminium roofing paint similar in colour to the original chassis colour.

Painting a chassis is OK if you really know how to paint well. My attempt is passable but with more experience and care I'm sure that the chassis would look better than it does. As time goes by, we all learn to achieve a higher standard of restoration.

Restoring the circuitry

During the 1950s era, HMV had the helpful habit of enclosing the chassis top in a frame, which meant that the chassis could be turned upside down for service without any likelihood of damage to the valves or other components.

Before I try out any new (to me) radio, I always overhaul the electronic circuitry and test it out of its cabinet. That way, I rarely get unpleasant and expensive surprises. The capacitors, transformers and resistors can all be tested with the set turned off and if shown to be faulty, can be replaced or repaired before any damage is done to other sections of the receiver.

Note that the paper capacitors must be tested with a high-voltage tester. If you don't have a high-voltage tester, the audio coupling capacitor (C27) between the 6N8 and the 6M5 valves should be replaced as a matter or course, along with all the AGC bypass capacitors (C4, C18).

Reforming the electros

My next step is to remove all valves except for the rectifier and check that there are no shorts between the HT line and the chassis. I then turn the set on and wait for about 30 seconds while the voltage from the rectifier rises to its peak. I then turn the set off again and monitor this voltage – it should slowly decrease. If it drops very quickly, it is probable that the main electrolytic filter capacitors need reforming.

My method of reforming electrolytic capacitors may be considered a bit brutal by some but with care, it is quite safe. The method is quite simple – after about a minute, when the voltage has vanished, switch the set on again, wait for the voltage to rise to a peak again and then switch off again. Do this several times and if the electrolytics are reforming correctly, you will find that the peak voltage increases and that the voltage disappears more slowly at switch off.

Note that while this method does overload the rectifier for a short period, it doesn't have the full set load to cater for.

If the plates of the rectifier glow red, you have a serious short between the HT line and the chassis and the set should be turned off immediately. You may have a component breaking down under load and the most likely culprit will be an electrolytic capacitor.

If there is no improvement, switch off, unplug the set from the mains socket and check the electrolytic and paper bypass capacitors for warmth (warning: make sure that the electro-

Photo Gallery: AWA Radiola 52G Dual-Wave Receiver

Housed in an attractive Bakelite "Tombstone" style cabinet, the Radiola 52G was manufactured by AWA in 1939. The set covers both medium and shortwave bands, with separate sections of the large glass dial being illuminated according to the band selected.

The valve line-up was as follows: 6A8-G frequency changer; 6U7-G IF amplifier; 6G8-G 1st audio/detector/AGC amplifier; 6F6-G audio output; and 5Y3-G rectifier. (Photo: Historical Radio Society of Australia, Inc).

lytic capacitors have been discharged before doing this). In this case, warmth equals faulty, so replace any capacitors that do get warm. Remember that some sets have a bleeder resistor across the power supply, so the voltage may still disappear reasonably quickly.

With all the valves out of the set (except the rectifier), the HT voltages on various stages can be checked within a minute. They should all read the same as long as there isn't a tapped bleeder resistor network across the power supply. In some receiver models, the screens of the RF and IF valves are fed through such a network.

I did all the above and replaced seven paper capacitors with much later polyester types. I also replaced the cathode resistor for the 6N8 audio stage. All other components including the electrolytic capacitors tested OK. The shielded wiring had perished, so it was all replaced to prevent shorts on the audio line in the future.

It was now time to try the set out with all the valves reinstalled. Initially, the performance was rather poor for such a high-performance set and the 6N8 IF amplifier was found to be slacking on the job and so it was replaced. In addition, the wave-change switch had suffered from the presence of the rodents and some bands weren't working. Its contacts were sprayed with contact-cleaning fluid and then operated many times to clean the sliding contacts.

Aligning the HMV 42-71

It was now time to align the set. However, as with all multiband receivers, this isn't quite as easy to do as on a broadcast-band only set.

First, the gang is fully closed and the dial pointer is aligned with the far edge of the clear glass (good one Mr HMV – a lot of other manufacturers don't tell you where the dial pointer should be with the gang closed). Aligning of the IF amplifier stages and the broadcast band is quite straightforward and my articles on alignment in December 2002 and January and February 2003 will assist you with this part of the job. The location of the various alignment points and the dial-drive layout were shown in an accompanying diagram supplied with the main circuit.

The shortwave alignment is a little different as the three shortwave bands all use a common coil for the antenna circuit, plus a common coil for the oscillator circuit. These coils are tapped in order to give the required tuning range for each band.

In practice, you can either connect your antenna/aerial to the receiver or do as HMV advise and use a 400Ω (390Ω will do) resistor in series with the aerial terminal to the signal generator. The signal generator must be tone modulated to carry out the alignment procedure.

First, set the wave-change switch to SW2 and the signal generator to 10MHz. Now tune the receiver to the 10MHz mark on the dial or to a point

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This front view shows the assembled receiver after it has been removed from its cabinet. The loudspeaker grille was resprayed with gold-coloured enamel paint to restore its appearance.

where the receiver just responds to the signal close to the 10MHz mark. That done, adjust the shortwave oscillator tuning slug until the 10MHz signal is heard on 10MHz, then adjust the shortwave aerial coil slug for peak performance.

Next, adjust the signal generator to 12MHz and adjust the shortwave oscillator and aerial trimmer capacitors so that the dial pointer corresponds to 12MHz for peak performance. Repeat these adjustments on both 10MHz and 12MHz until correct calibration is achieved at both frequencies.

Now switch to SW1 and tune the signal generator and receiver to 15MHz. The receiver may not tune to the signal generator exactly on the 15MHz point but there is nothing you can do about this. The shortwave antenna circuit is now adjusted for peak performance and this is done by altering the position of the wire connected to the first tap, which is nearest the coil base.

To adjust this, file a small slot in the end of a non-metallic knitting needle and use the needle to adjust the position of the wire for best performance. It's an unusual method of alignment but it works. The wire can be seen near the aerial coil (near the rear of the chassis), as shown in one of the photographs.

Note that there are no adjustments for shortwave band three (SW3), as the manufacturers relied on the manufactured accuracy of the coils and the close-tolerance of the fixed band-spread capacitors.

By the way, if you don't have a signal generator, it's possible to look around for the WWVH time and frequency stations on 10MHz and 15MHz. These stations put out a pulsed tone signal every minute.

And that completes the alignment, although the performance won't be quite optimum and some of the frequency calibrations will be slightly inaccurate. In general, the dial-scale is remarkably accurate, with a maximum error of 120kHz at 18MHz and no more than 50kHz on the other two shortwave bands. By contrast, many dual-wave receivers are 500kHz or so out of calibration on the shortwave bands.

To overcome these relatively slight inaccuracies on shortwave, many people put pencil marks on the dial to mark their favourite stations. However, because of the touchy nature of the tuning on low-cost dual-wave receivers, the user often still could not be 100% sure they were tuned to the sought-after station – even with the pencil marks. This is not a problem with the 42-71, however.

Summary

Although HMV designed this radio for the lower-priced end of the market for serious shortwave listening, it works quite well. The set is quiet when not connected to an antenna and both man-made and natural noise become apparent immediately an antenna is connected. It is sensitive, although it could do with a little more IF amplifier gain (I'm fussy).

The dial calibrations are remarkably accurate, the alignment is quite straightforward and the audio quality is good due to the use of generously-sized components and good design. What's more, it is easy to service and is an attractive set to look at.

The only criticism I have is that although the control functions and positions are shown on the dial-scale, the band change and tone controls have no indications as to what position they are in. That said, the HMV 42-71 is noticeably superior to the average dual-wave 5-valve receiver. I'm more than happy to have it in my collection. **SC**

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EGO sensor connections for mixture meter

I have a few queries about the mixture meter kit from Dick Smith Electronics. The recommended oxygen sensor is the Bosch LSM11 which we have obtained. Since there is only one yellow wire coming from the PC board to connect to the LSM11, to which wire does it connect and to what do I connect the other three wires of the LSM11?

The LSM11 has two plugs – one plug has two white wires with male pins and the other has a black and grey wire with female connectors. (T. S., via email).

● You will need to measure the resistance between the wires. There is a heater coil which should measure some low ohm value between two of the wires. The ground wire for the sensor should show zero ohms to the case while the signal wire should be a high impedance to ground.

Probably the two white wires are the heater, while the grey and black wires are for the sensor. The high impedance sensor output connects to the signal input on the mixture meter. The ground connects to the same ground as the mixture meter.

Note that it is not necessary to connect the heater to the 12V supply as the sensor will heat up via the exhaust.

If you do not connect the heater, you can test each wire combination with one wire to ground and the other to the mixture meter until the meter shows the fuel mixture reading.

Mid-band tone control for PortaPAL

I am interested in the PortaPAL amplifier described in January & February 2003. I want to use it for a headphone amplifier for a bass guitar while performing on stage and as a practise amplifier head. Is it possible to add a middle frequency parametric pot onto this circuit? (R. S., via email).

● We published a parametric equaliser in the July 1996 issue of SILICON CHIP. This could be used to replace the bass and treble control circuit. The grounded connections on the circuit would need to connect to the half supply (6V) rail of the PortaPAL. The input potentiometer (VR1) would not be required.

Alternatively, you could add the mid-band circuit for the tone control used in the Guitar Amplifier published in November 2000. Just add the mid-band components from the guitar tone control (VR3, the 2.7nF capacitor and the 12kΩ end resistors) to the PortaPAL tone control circuit.

Concern for Onkyo receiver rating

I have recently purchased a pair of Vifa JV60 speakers (described in August 1995) from Jaycar Electronics. They are rated at 4Ω. I am having difficulty finding an affordable receiver/amplifier to drive them.

The receiver that I am considering is an Onkyo TX-8511 because I can get it really cheap! However, Onkyo have told me that the amplifier does not support 4Ω speakers. It is rated at 130W/channel for 6-ohm loads.

This particular receiver, listed in the USA website with the same product code, seems to support 4-ohm speakers however the same product in Australia does not. Could this be because of a design regulation affecting what they can actually say? The amplifier apparently has a large heatsink and runs with a high current which is supposedly good for supporting lower impedance drivers.

The options that I have are either: (1) ignore Onkyo's recommendation and use it with the speakers but be careful with the volume levels and heat build-up of the receiver or add a resister to the speaker crossover to bring it up to 6Ω; or (2) not use the amplifier at all because it is completely unsuitable.

Given that I am only keen to spend about $500-$700 on an amplifier, what do you think is the most suitable solution to driving these speakers? If adding an extra resistor to the speaker is feasible, where would be the most appropriate position for it to be installed and what resistor would you suggest? (J. D., via email).

● You have two options. Just operate

Bridging the SC480 amplifier modules

I liked the presentation of the SC480 amplifier in the January 2003 issue. I couldn't believe it. I built the ETI480 in 1981 and did countless gigs with it as a DJ. That thing was OK but I agree with you that the specs were not great. I saw somewhere that some 100,000 units were sold and built. I wish the SC480 the same success! I really liked the way you presented it with different transistors and a very informative and well laid out article.

I was wondering if the SC480 could be bridged to produce more power? If so, does the power supply need upgrading? I am looking for a high-power amplifier at around 200W in 8-ohm loads and was looking at a bridging adaptor. I need to know how safe and effective bridging is and if SILICON CHIP has a bridging adaptor? (E. Z., via email).

● Two SC480 modules can be bridged to produce around 200W music power into 8-ohm loads. Do not beef up the power supply otherwise you could push things over the limit. A suitable bridge circuit and PC board was featured in the June 1985 issue of "Electronics Australia". We can supply a photocopy for $8.80, including postage.

Ultra-Bright LED Lamps For Spa Lighting

I was intrigued by your article "LED Lighting For Your Car" in the March 2003 issue. I have a submerged red light in an indoor spa. The light source is a 24V 150W halogen lamp. The whole installation is unsatisfactory for a number of reasons but high on the list of problems is the intense heat generated by the 150W quartz lamp.

There is plenty of room inside the lamp housing but thermal conductivity will be poor as the entire casing is plastic several millimetres thick. When one considers that there is warm water outside this, it is clear that internal temperatures must be very high. I believe that internal pressure changes, due to temperature variations, also add to sealing difficulties.

It seems that this would be an ideal application for a red LED array but there a couple of questions. How many red LEDs would I need, to approximate the light output of a 150W quartz halogen globe? The existing system uses a 24VAC transformer which I propose to full-wave rectify. It would be nice to avoid the need to use a 24V regulator, so will the peak rectified waveform be a problem? (E. T., via email).

● You would need dozens of ultra-bright red LEDs. Typically, we have used 12-16 20000mcd LEDs to replace a 21W stop light.

On that basis, to replace a 150W red lamp (and allowing for the fact that the lamp is a halogen type which are more efficient than the standard incandescent car stop lights, you would need at least 150 LEDs, and maybe a lot more, to get the same brightness. We don't think it is practical.

the JV60s with your Onkyo and don't worry – it is unlikely that you will blow anything unless you really turn up the wick and even then you probably will only blow a fuse in the amplifier.

A check of the impedance curve for the JV60s in the August 1995 issue of SILICON CHIP shows that they could have been rated a nominal 6Ω anyway; the impedance barely dips below 4Ω at a couple of points in the audio spectrum.

If you are still worried about your Onkyo and want to protect it, connect a PTC thermistor in series with the amplifier outputs. Use the same Polyswitch PTC (Jaycar Cat RN-3470) as we specified in the SC480 amplifier described in the January/February 2003 issues.

Engine knock sensor required

I am looking for a voltage amplifier. The input will be from zero to 250mV and output up to 5V DC. It is needed to convert the voltage signal from engine knock sensors to a higher voltage so the EMU can read the signal (up to 5V DC).

Will an audio amplifier with an AC-DC converter do? (J. C., via email).

● The engine knock sensor described in the April 1996 issue of SILICON CHIP has the essential ingredients you require. These are the amplifier (IC1a with adjustable gain from 2 to around 200) and a DC converter comprising diode D1, a 1μF capacitor and a 1MΩ resistor.

24V SLA charger wanted

I need to trickle-charge two 12V 7Ah SLA batteries in series. Your new charger for the PortaPAL seems ideal with a few modifications for 24V operation.

Apart from a 32V plugpack, I imagine I would have to change VR7 to 1kΩ, the 220Ω resistor feeding the relay would have to be a higher value, the LED current limiting resistor would have to be changed to about 470Ω and the electrolytic capacitor voltages increased to 50V or so. Anything else? Is this an oversimplification? (B. P., via email).

● 24V operation would require using a 32V plugpack and changing the capacitor voltage ratings to 50V as you suggest. VR7 should be changed to 1kΩ and the series 1kΩ resistor changed to 2.2kΩ.

The 2.2kΩ resistors in series with each LED should be changed to 4.7kΩ. The relay can be changed to the 24V version (Altronics Cat. S4162A) and the series resistor changed to 1kΩ 5W.

Using 70V rails with Plastic Power amplifier

I am interested in building the Plastic Power amplifier published in the April 1996 issue of SILICON CHIP. I already have a really nice transformer but the problem is that it's going to give me ±70V supply rails, significantly higher than the 59V specified in the design. My question is, do you think I'll get a way with it?

From what I can tell, all the semiconductors are rated at the higher voltage. If I avoid a 4Ω load and only run 8Ω, do you think I'll come in under the SOAR? (S. T., via email).

● We had to go back to the SOAR curves to check out your question. The answer is yes, provided you use only 8Ω loads, the amplifier is safe with 70V supply rails. But if your speaker impedance curves dip to down below 6Ω anywhere in the audio range or the supply rails go much above 70V, you run the distinct risk of blowing your amplifier.

If it was our choice, we would not do it. If one of the output transistors fails because of overload, you will probably also lose the speakers in that channel and you could even have a fire! In fact, you should build the Loudspeaker Protector from the April 1997 issue.

Confusion over diode D3

I refer to the article "Adjustable DC-DC Converter For Cars" in the June 2003 issue. On pages 71 and 72 are photographs showing the assembled circuit board for this project. In both cases D3 is replaced by a wire link and I could not find any reference to this in the text. The text does say that D3 has another purpose besides guarding against reverse polarity and that is to limit the output voltage in the event of a high input voltage.

I assume D3 was not fitted to the development unit on the basis of being not needed for a unit being carefully tested by a competent person but I am left with the lingering doubt as to whether there is any other significance in its omission. (E. W., via email).

● Diode D3 was initially intended to be optional depending on application. The photograph was taken before the decision to keep it in-circuit in all cases.

The unit was tested with D3 in circuit as well as out of circuit.

Using the 4-channel remote

I am helping out a team from Sailability (volunteers who help disabled people to sail) who have a buoy fitted with a beeper which is used to guide vision-impaired sailors around a marker. At this time they are using a 12V reversing beeper which they have to go to and switch on. As a result, it is operating for some time and the constant noise is upsetting some of the locals.

We are assembling the Long-Range UHF 4-Channel Remote Control to solve the problem. But my question is, if another buoy was fitted with a receiver, could the transmitter be used to trigger the two buoys on independent coding or could channels A and B be used? (F. N., via email).

● If you have the receivers in latched mode, you could have up to four for your application, with each receiver operating off one channel.

Another solution for ignition breakdown

I have just read response to the question entitled "Crossfire Problem in Multi-Spark Ignition" on page 92 of the December 2002 edition.

Rather than being crossfire, the problem is more likely to be that the Hall effect sensor is firing prior to the rotor button being lined up with the distributor cap. The vacuum advance will be causing the behaviour. If he removes the distributor cap, there will be obvious spark marks on the leading or trailing edge of the rotor button.

The solution is to remount the sensor back or forwards by about 10 degrees or play with the vacuum advance. (P. Y., via email).

Reluctor problem with multi-spark CDI

Having completed the Multi-Spark Capacitor Discharge Ignition (SILICON CHIP, September 1997), it appears the triggering from my reluctor distributor is not happening. What could be wrong? The distributor is fine and swapping the reluctor wires over to it does not help.

When power is first applied there is a discharge into the coil, as I can hear it and see it with my timing light. On testing the inverter circuit to your recommendations, I can measure 300V between the case and the tab of Mosfet Q6. (W. M., via email).

● The reluctor signal sensitivity can be altered by changing the 47kΩ resistor which connects from the cathode of ZD5 to the other 47kΩ resistor which connects to the base of transistor Q8. Use a 200kΩ trimpot first and adjust it until the ignition fires. Then replace the trimpot with a fixed value resistor of the same value. **SC**

LM3876 amplifier module re-rated

I was looking to build some of the LM3876 amplifier modules featured in the March 1994 issue for an active crossover system. I just want to confirm the performance measurements quoted in the original article. Does the amplifier really supply 55W into 4Ω? Looking at the data sheet for the LM3876 chip, I cannot see how this would be possible.

If you look at page 9 on the data sheet it has a plot of output power vs. load resistance. This shows that for an RL of 5Ω, the output power would only be 15W. (B. H., via email).

● We certainly measured 55W into 4-ohm loads when we presented the device in 1994 but we don't have access to the original data handy. Looking at the current data on-line, it looks as though the chip has been re-specced to severely limit power for loads below 8Ω. In that case it will be better to use the higher-spec device LM3886. This is optimised to deliver more power into 4-ohm loads – up to 68W (typical).

This was featured in a dual power amplifier module in February 1995. It uses the same basic circuit as that in March 1994 but the supply rails must be reduced to ±28V for operation with 4-ohm loads.

In view of the supply/load limitations, you may want to consider using the SC480 module featured in the January & February 2003 issues. These deliver quite a lot more power with typical program signals.

Notes & Errata

50W Amplifier Module, March 1994: the LM3876 used in this design has been changed to severely limit its power output into 4-ohm loads. If you want to use a 4-ohm load, the solution is to use the LM3886 which can deliver over 60W. However the supply rails should be reduced to ±28V, as recommended in the article for the LM3876 when using 4-ohm loads.

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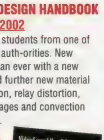

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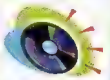

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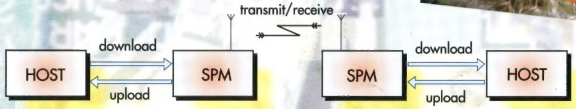

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